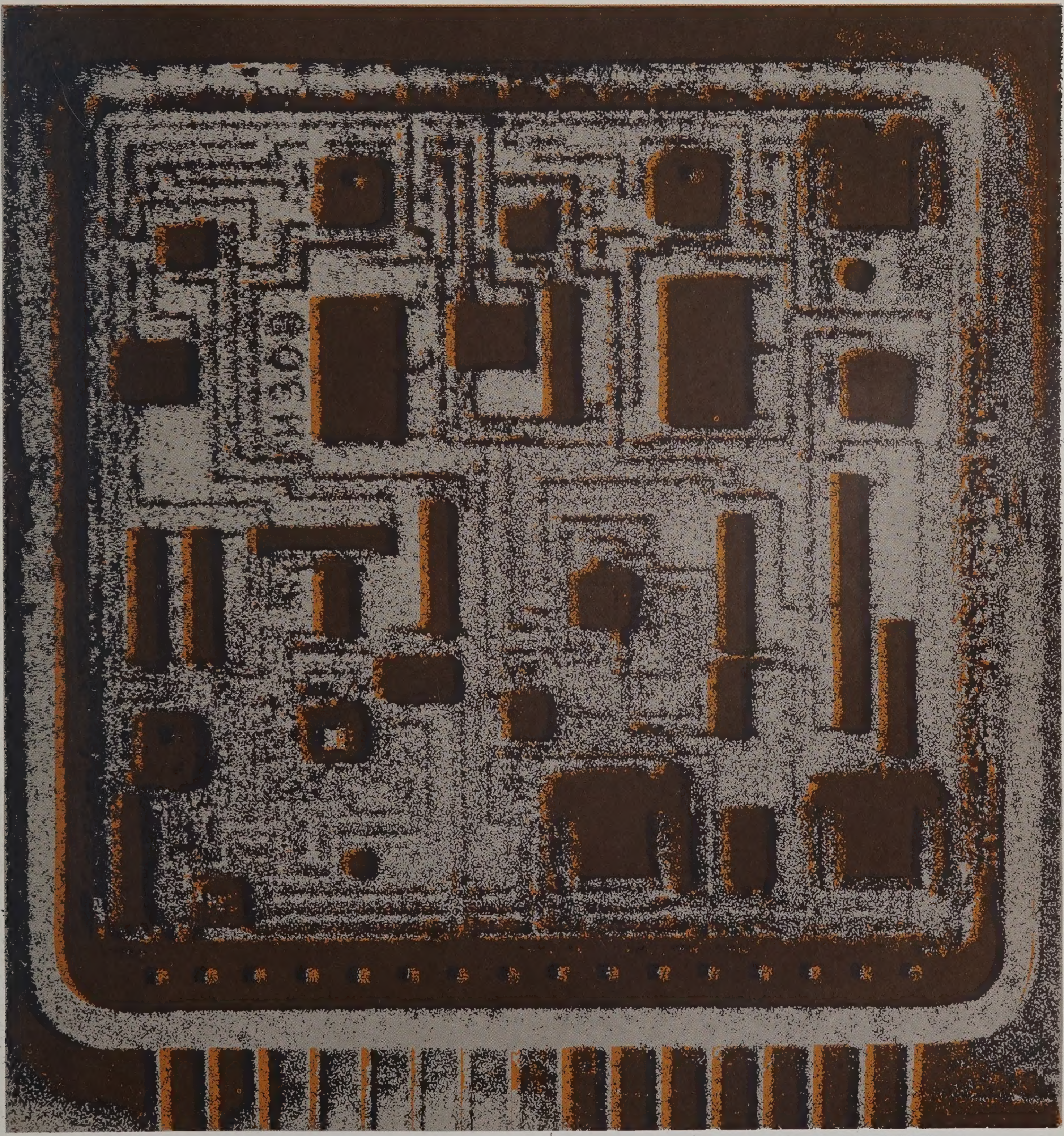
DIMENSIONS NBS

The magazine of the
National Bureau
of Standards
U.S. Department
of Commerce

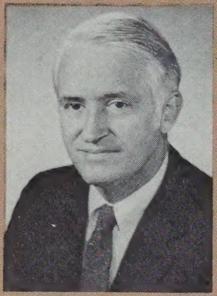
July 1977



A PRIMER ON PRESSURE. See page 3.

COMMENT

THE NBS IDENTITY CRISIS



The five-year experience of sitting on the Statutory Visiting Committee of the National Bureau of Standards has been particularly stimulating and interesting because my own daily work is essentially non-technical. Yet, I found that the management issues that have been discussed and reviewed with the Visiting Committee are quite similar to those that are faced in the everyday non-technical world. I am strongly convinced that NBS is an institution of infinite value to the country, one that is performing well and is in quite good physical condition, but one that is at the moment suffering with an old-fashioned identity crisis.

The Bureau's fundamental scientific work in the many mission areas of metrology is unmatched anywhere. The basic data and reference information on materials published by NBS are most comprehensive and solidly documented. Computer technology has been supported by NBS work from its infancy. The broad-gauged national effort of applying technology is led by NBS in many, many fields.

Yet, there are some people who apparently fear that "science is dead at NBS." There are some who seem to feel that "there is too much concern about current national problems rather than about good science." Others, on the other hand, wonder whether NBS is "sufficiently challenged toward external concerns, such as the energy problem."

The Identity Crisis is a phenomenon that is usually seen only in healthy organizations. The existence of the crisis shows that the organization has several vital and distinct segments, that the various segments have vocal constituencies, and that there is some kind of change taking place.

I believe that all the competing segments at NBS should see that the good, the basic scientific work being undertaken at NBS, *must* be supported and must receive *additional* support in the future years.

They all should see that the service functions of the Bureau are necessary if the scientific community is to receive the benefits of the work that has been done. These service functions *should not* be reduced.

They all should see that NBS must respond to the mandates of Congress and to the needs of our society to apply technology to meet important national problems.

NBS should not continue its Identity Crisis. It has little choice but to fulfill *all three* of the above roles.

Let's focus attention on becoming more successful in getting resource support for *all three* of the NBS roles. I believe this is everybody's job—not just the job of the Bureau management.

Those doing basic research should be quick to envision and to articulate the relevance of their work to the larger scheme of things. Certainly the research should be supported simply because it is good basic work. But, it will get *more* support if the potential meaning of the work is communicated and understood.

Those doing service work should increase their communications about the benefits that flow from the work and the necessity of its being done correctly.

Those doing applied work should focus their efforts only on work that NBS is better equipped to do than any other organization. Such a focus will improve the quality of the work and the speed of its output, thereby enhancing the credibility of NBS to all.

The management of NBS carries the prime responsibility for gaining additional resource support. It strikes me that in this process:

- *More* stress in their communications, not less, could be placed on the basic research that is being done at NBS and its importance to society. The politically popular work that relates to the needs of the moment requires less reinforcement to obtain support. Basic research is always supported on the basis of faith in the future and faith in the researchers, not on promises of immediate reward. Basic research is initiated in the regimes of leaders who have broad faith in the future and broad vision. But, the leader supporting that long-term research needs to be backed up with good communications about the benefits of the research work.
- The NBS arguments for more support require the *active* support of the Secretary of Commerce if these arguments are to carry past all the negative obstacles in the system. If only passive top-level support is obtained, then the lower-level bureaucrats are likely to pick apart the requests.
- The leadership should continue to look for ways to affect favorably the systems by which money flows to the Bureau.

I come away from the five years I have had with the Visiting Committee with a terribly high regard for the people in NBS. Their scientific skill, their integrity, their openness, their patience in dealing with the system are all outstanding. The give-and-take that flows from the system of National Academy review panels results in a tremendous quantity of interchange of communications and technology.

NBS is a *great* institution. Its various segments should put away the Identity Crisis and unite in working to get for NBS the *great* support it should have.

C. E. Peck

C. E. Peck
Group Vice President,
Building Materials Group
Owens-Corning Fiberglas Corporation

Last month, Peck ended a five-year appointment as a member of the NBS Statutory Visiting Committee, which he chaired during his final year. The five members of the committee, chosen by the Secretary of Commerce from the industrial and business community, review the programs and facilities of the Bureau and report annually to the Secretary.

NBS DIMENSIONS

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National Bureau of Standards
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Volume 61//Number 7

July 1977

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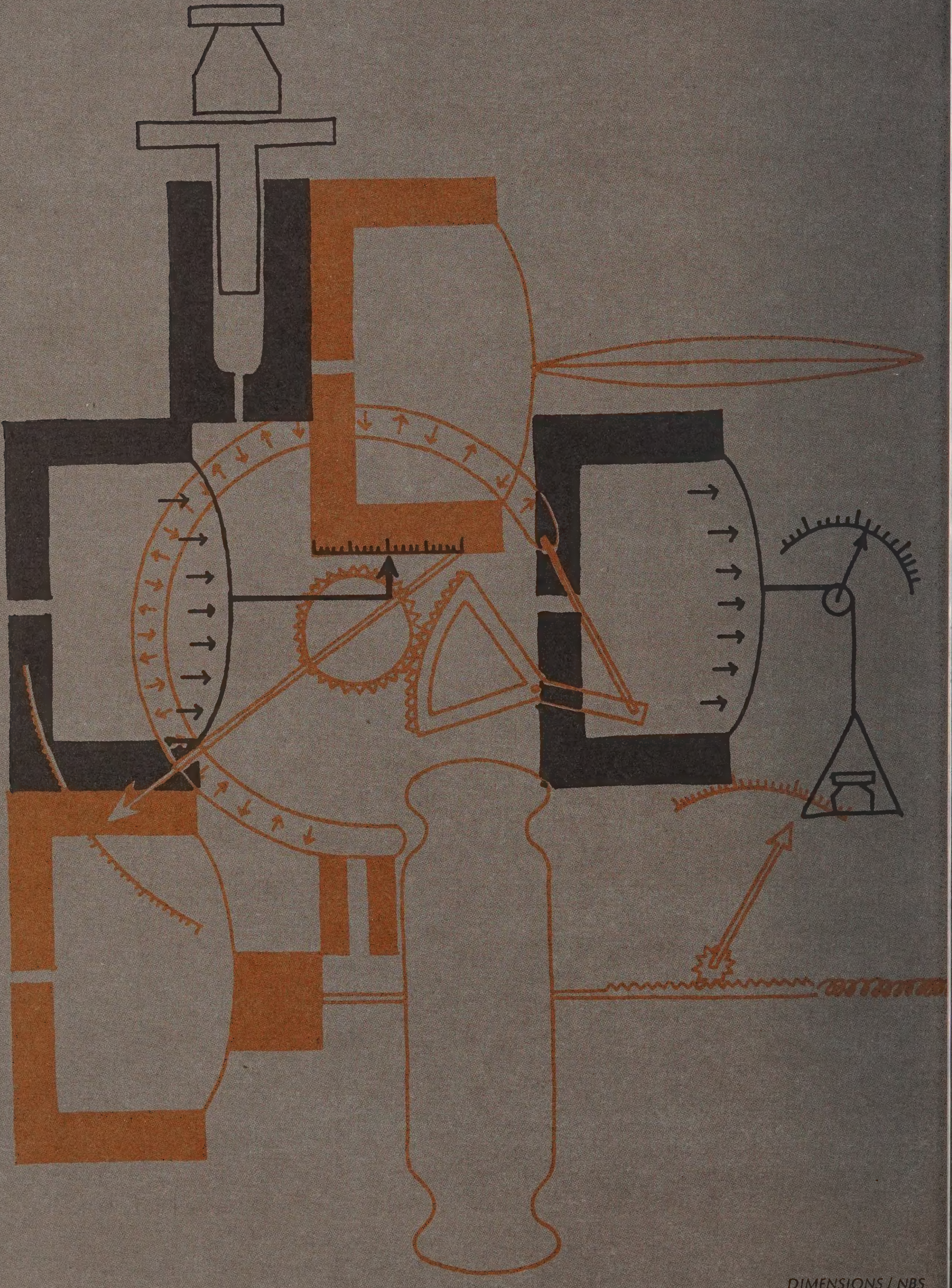
A Primer on Pressure



COVER STORY

by Peter L. Heydemann

WHEN we set up a barometer and do a little home weather-forecasting, or fill the tires on a car, we are making a very direct and obvious use of pressure measurement. But the accurate measurement of pressure affects our daily lives much more than even these examples would suggest.

Not only automobile tires, but automobile engines, as well as airplanes, refrigerators and furnaces depend upon pressure measurement. Industrial processes such as the vacuum melting of steel, transportation of fluids through pipelines, manufacture of semiconductors, powder metallurgy and freeze-drying of foods, to name a few, depend on the measurement and control of pressure.

Yet though the measurement of pressure is an important—and fairly old—field, by scientific standards it is not well structured. In temperature measurement, for example, there is a thermodynamic scale that provides a theoretical base for temperature measurement and an International Practical Temperature Scale to aid in the precise calibration of thermometers. There are no comparable scales for pressure.

Pressure measurements made and used in science and industry range from about 10^{-10} to 10^{12} pascals (newtons per square meter). In the measurement of distance, that would correspond to the difference between measuring the diameter of an atom and measuring the distance from Earth to Sun. The problems at one end of the scale have little to do with the problems at the other end. Part of the difficulty in understanding how pressure measurements are made and used in industry and commerce lies with the rather wide variety of units and instruments used to define and measure pressure (or vacuum). What follows is a brief introduction to the mechanisms and language of pressure measurement.

> *"Pressure measurements made and used in science and industry range from 10^{-10} to 10^{12} pascals. In the measurement of distance, that would correspond to the difference between measuring the diameter of an atom and measuring the distance from the Earth to the Sun."*

Definitions

Pressure (p) in the fluid is defined as the force (F) exerted by the fluid on an area (A), or:

$$p = \frac{F}{A}$$

Under *static* (no movement) conditions, the pressure at a point in the fluid is the same in all directions, but it decreases with increasing elevation in the fluid. In a fluid like water, which has a constant density (ρ) the difference between the pressure at two different depths (h_1 and h_2) is given by:

$$p_1 - p_2 = \rho(h_1 - h_2)$$

In a compressible fluid, such as air, the expression is more complex:

$$p_2 = p_1 e^{(h_1 - h_2)C}$$

where C is a constant for the fluid. The pressure in communicating vessels is the same everywhere at a given elevation as long as the fluid is not moving.

In *dynamic* systems, where the fluid is moving, the pressure decreases downstream because some of the energy is used to move the fluid and overcome losses from flow resistance and the viscosity of the fluid. The dynamic pressure p_v in a moving fluid is related to the kinetic energy of the fluid and is proportional to the square of the velocity of the fluid.

$$p_v = \frac{V^2}{2}$$

In compressed (ideal) gases, pressure is proportional to the temperature of the gas and inversely proportional to the specific volume:

$$p = \frac{RT}{V}$$

where R is the universal gas constant.

Pressure Units

Since pressure is defined as force per unit area (or sometimes energy density), the units of pressure should be rather simple to list. However, on closer inspection we realize that there are many units in which to express force and area and consequently an even larger number of combinations of the two. The situation is complicated by the fact that people using manometers tend to measure pressure by the height of the fluid column, rather than in terms of the force necessary to raise the fluid column.

The official unit of pressure in the Système International (SI) is the newton per square meter (N/m²), which is also called the pascal (Pa) after the French scientist who sent his brother-in-law up a mountain with a mercury barometer to measure elevation.

The accompanying table lists some of the more frequently encountered pressure units, together with

turn page

Standards for the physical measurement of quantities such as pressure are developed and maintained by the National Bureau of Standards. They form the basis for the measurement systems fundamental to science and industry. One step in producing the integrated circuit shown on the cover involves the vacuum-deposition of metallic films. Many such circuits are sealed under pressure, and are then leak-tested using another pressure process. These and the many other, varied applications of pressure depend on the measurement system described in this article.

Dr. Heydemann is chief of the NBS Pressure and Vacuum Section in the Institute for Basic Standards.

Figure 1—Basic Piston Pressure Gage. The piston and mass are rotated to reduce friction between the piston and the walls of the cylinder.

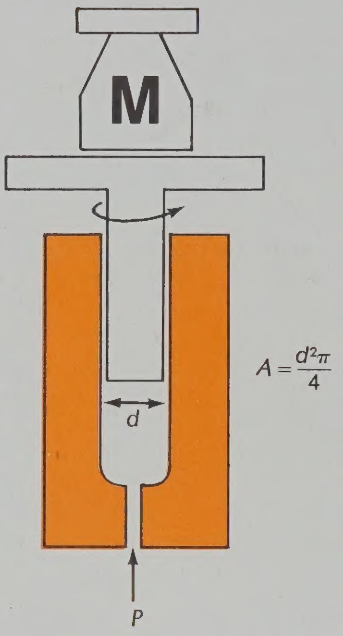
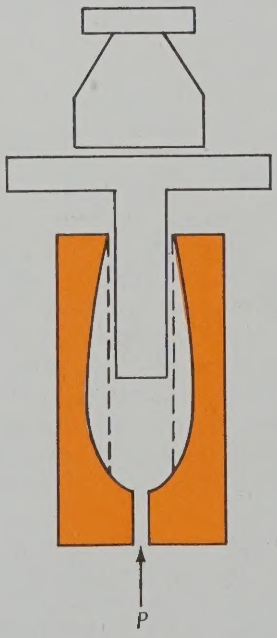


Figure 2—Pressure in the Piston Gage Distorts Both the Walls of the Cylinder and the Piston, Changing the Area Where Force is Applied and Causing Inaccurate Measurements.



their equivalents in pascals. The three most common units besides the pascal are the torr (or millimeter of mercury) for vacuum measurements, the pound per square inch for low and medium pressures, and the kilobar (1 × 10^8 pascals) for high pressures.

Conversion Factor to Pascals for Various Pressure Units

To convert from	Multiply by
atmosphere (normal = 760 torrs)	101 325.0
atmosphere (technical = 1 kgf/cm²)	98 066.50
bar	100 000.0
centimeter of mercury (0°C)	1 333.22
centimeter of water (4°C)	98.063 8
decibar	10 000.00
dyne per square centimeter	0.100 0
foot of water (39.2°F)	2 988.98
gram-force per square centimeter	98.066 5
inch of mercury (32°F)	3 386.38
inch of mercury (60°F)	3 376.85
inch of water (39.2°F)	249.082
inch of water (60°F)	248.84
kgf/cm²	98 066.50
kgf/m²	9.806 65
kgf/mm²	9 806 650.
kip/in² (ksi)	6 894 757.
millibar	100.000
millimeter of mercury	133.322
newton per square meter	1.000
poundal per square foot	1.488
pound-force per square foot	47.880 26
pound-force per square inch (psi)	6 894.757
torr (mmHg 0°C)	133.322

Basic Pressure Measurements

Pressure can be measured in many different ways, but in order to establish the basic pressure scale, with which all other pressure gages are calibrated, we refer to the defining equation and measure pressure directly as a force exerted on a well known area. Two principal types of devices have emerged for this purpose: the piston gage for pressures above atmospheric pressure and the manometer.

Piston gages consist of a dead-end cylinder into which a close-fitting piston is inserted. The piston can move freely up and down inside the cylinder. In very accurate piston gages such as the ones used at NBS, the piston is continuously rotated about its vertical axis to form a lubricating fluid film between piston and cylinder and thus to relieve friction (see figure 1).

An unknown pressure applied to the port at the bottom of the cylinder will push the piston out with a force F_p

$$F_p = pA$$

This force is balanced by placing sufficient weights with mass m on the top of the piston to make

$$F_M = mg = F_p = pA$$

Then with the area of the piston $A = d^2\pi/4$ and the mass m known the pressure p can be calculated.

However, in order to establish a highly accurate pressure scale numerous corrections have to be applied to these measurements of force and area: The force of gravity on mass m is reduced by the air buoyancy effect; the diameter of the piston is a function of temperature; errors in the vertical alinement lead to errors in the applied force; fluid films may form between the piston and the top of the cylinder influencing the applied force; pressure distorts both the piston and cylinder and thereby changes the area A; fluid leaks through the clearances between piston and cylinder, and its drag influences the measured pressure. There are numerous other corrections that must be considered and made in order to establish a pressure scale that is more accurate than the most demanding measurements made in the country.

One correction cannot be made with sufficient accuracy: the correction for elastic distortion of the cylinder by the internal pressure (figure 2). The *controlled clearance piston gage* was therefore developed to maintain a constant clearance between the piston and the cylinder regardless of the internal pressure (figure 3). In the controlled clearance piston gage the measuring cylinder is surrounded by a second cylinder. The space between the two is filled with oil at a carefully controlled pressure p_c which counteracts the internal pressure. A group of such gages at the National Bureau of Standards is used to establish the pressure scale from 2 kPa (0.3 psi) to 2.5 GPa (370 000 psi).

A manometer consists of two vertical tubes partially filled with a liquid of very well known density (see figure 4). The tubes are connected at the bottom. One tube is open at the top; the other tube is connected to the pressure to be measured. This pressure pushes the liquid down in the pressurized column and up in the other until the force of gravity per unit area of the fluid column above the line "0—0" equals the pressure

$p = gh\rho$ g acceleration of gravity
ρ density of fluid
h column height

Since the atmospheric pressure presses on the fluid surface in the vented tube, the measured pressure

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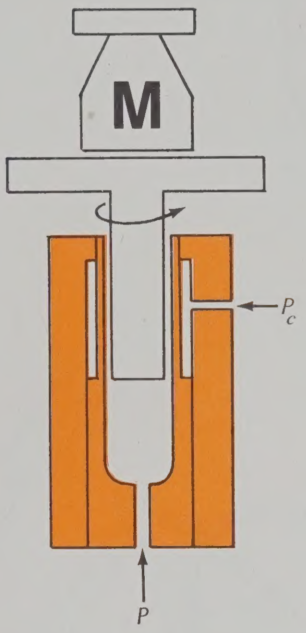


Figure 3—In this Controlled Clearance Piston Gage, a Control Pressure (P_c) Counteracts the Distortion of the Cylinder Walls.

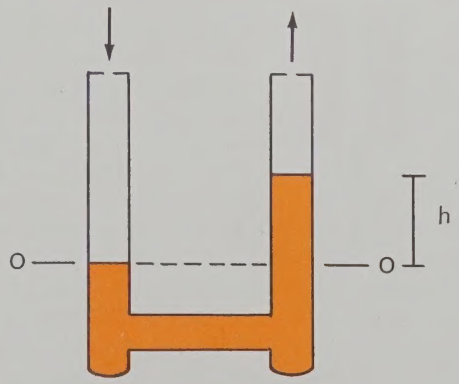
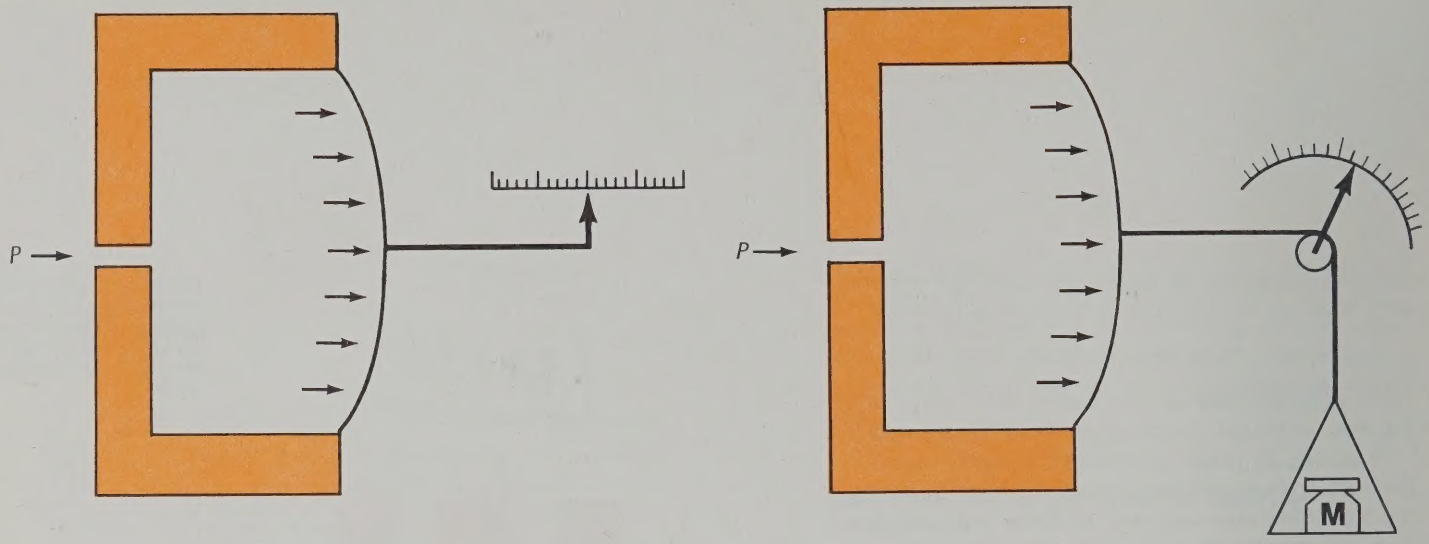


Figure 4—Simple Manometer.



Figures 5 and 6—Many Transducers Measure Pressure by the Distortion of Some Part, Such as a Diaphragm, Under Pressure.

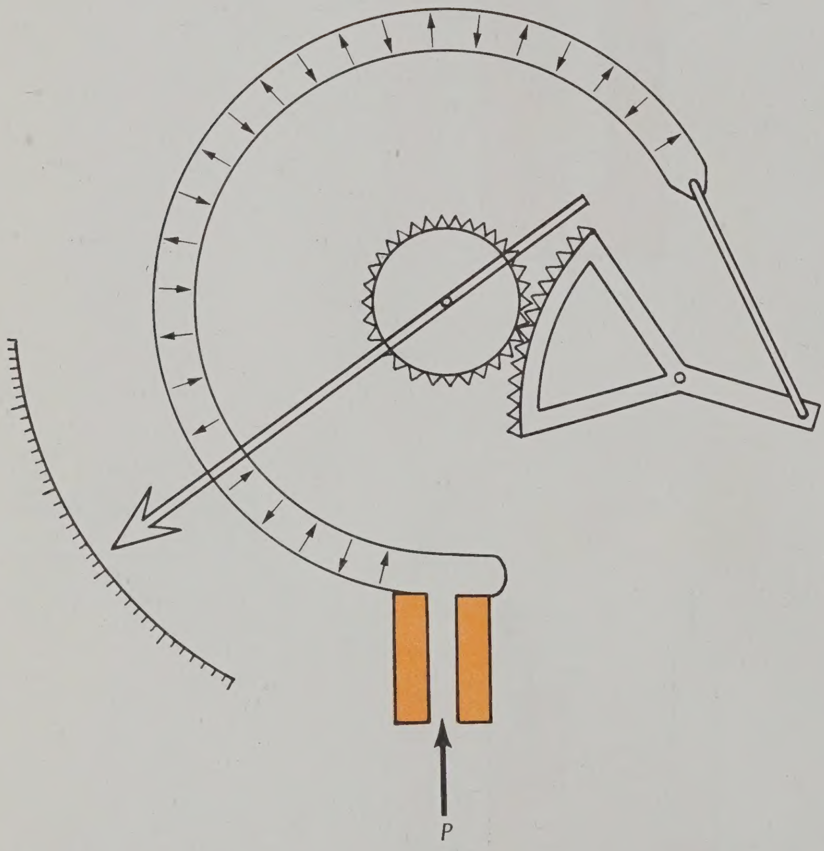
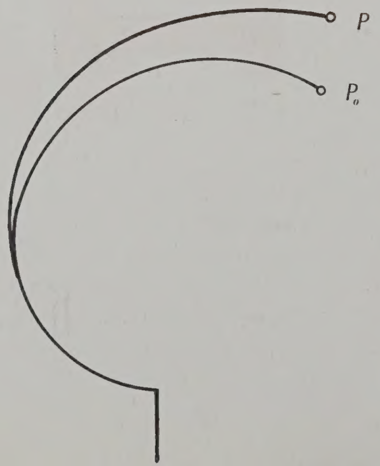


Figure 7—In this Bourdon Gage, a Change in Pressure from P_o to P Inside the C-Shaped Tube Causes the Tip of the Tube to Bend Away from the Center.



in this case is in addition to the atmospheric pressure. This is also loosely called the gage pressure. To measure absolute pressure the reference tube is connected to a vacuum pumping system rather than to the atmosphere.

There are clearly four tasks to be performed: One has to locate the exact position of the fluid menisci, transfer these positions to a scale, measure the difference in height between them to obtain *h*, and determine the density of the liquid.

As with the piston gage, there are numerous corrections to be applied and many precautions to be taken to make measurements accurate enough to establish the pressure scale: the tubes must be extremely clean and wide enough to minimize errors due to variations in surface tension at the tube-fluid-gas interface, the temperature of the fluid must be uniform and extremely well known, the scale temperature must be known, the scale must be vertical, the reference vacuum, if used, must be measured, etc. It seems that the major problems are in locating the menisci, measuring their distance from a fixed point, and knowing the temperature of the liquid. To overcome these difficulties we are building a manometer that uses mercury as manometric fluid and laser interferometers to locate the mercury surfaces and to measure their distance. The entire manometer is enclosed in a thermally insulated box to keep the temperature of the liquid uniform. Other manometers at the National Bureau of Standards use ultrasonic interferometers to locate the menisci and to measure their vertical separation. Together, our manometers cover the range from 1 Pa (0.0002 psi) to 200 kPa (30 psi).

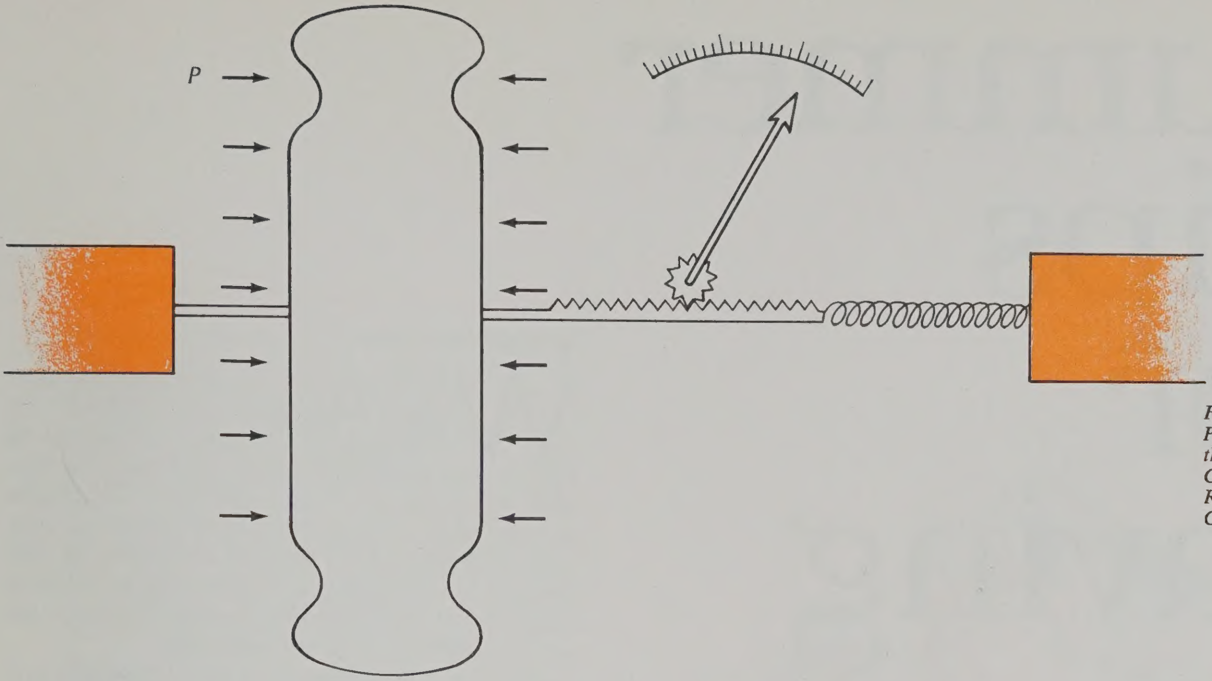


Figure 8—Atmospheric Pressure on the Walls of this Evacuated Capsule Causes a Pointer to Move, Registering Pressure Changes.

Industrial and Commercial Gages

Piston gages or manometers, while being very precise and stable, are not practical for most measurements at the point of use in industrial plants, airplanes, power stations, missiles, gas stations, pipe lines, and so forth. A large number of transducers and gages have therefore been developed which convert pressure into an analog pointer position, voltage, current, frequency, etc. There are many transducing principles, but the most widespread is the use of members that deflect under the influence of pressure. This deflection is then transformed into a suitable mechanical or electrical signal.

Many transducers are based on the deflection of a diaphragm caused by the unknown pressure (Figure 5). This deflection can be measured by means of strain gages, differential transformers, capacitors, mechanically coupled potentiometers or pointers (Figure 6).

Other transducers and particularly most indicating gages use the deflection of a C- or Bourdon tube (Figure 7). This deflection is generally mechanically coupled to a pointer but can also be measured with differential transformers, reluctance devices or potentiometers.

For barometric pressure measurements, evacuated capsules or bellows are frequently used (Figure 8). Under varying barometric pressure these capsules will collapse more or less against an external or internal spring force, and the resulting deflection can again be sensed in any one of many ways.

Most of these mechanical devices in order to be sensitive are designed for large deformations. The resulting mechanical hysteresis or lag is one of the largest sources of inaccuracy in these devices. Force-balanced transducers avoid this problem by measuring the force required to hold at least one point of the deflecting member stationary against the action of the pressure.

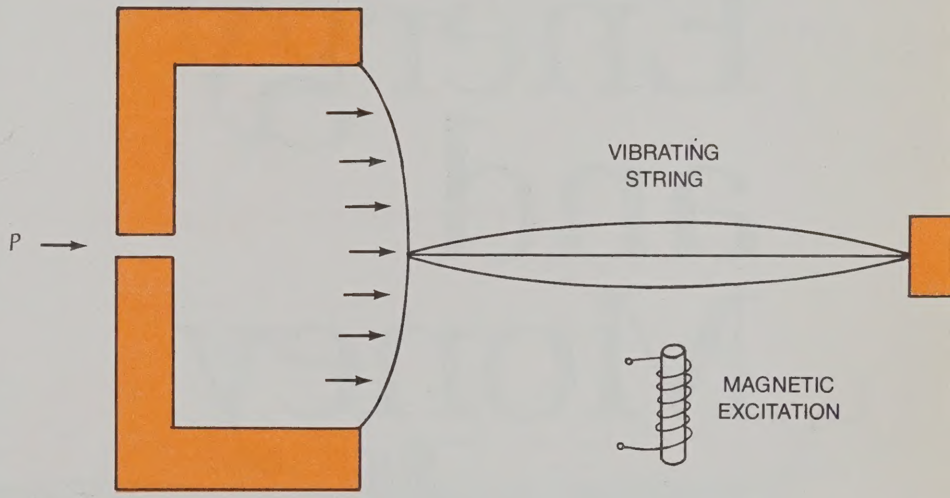


Figure 9—This Transducer Measures Pressure by Registering the Change in Pitch of a Vibrating String When Pressure is Applied to the Diaphragm.

A different group of transducers exploits the effect of pressure on the mechanical resonance frequency of the strained part (Figure 9). This part could be a string stretched between the membrane and a support or a cylinder oscillating in a complex mode. In either case, the application of pressure affects the resonance frequency through a change of the elastic properties of the vibrating member.

Some transducers, especially those operating at very high pressures, use the influence of pressure on bulk properties of a fluid or solid as the transducing principle. Pressure changes the speed of sound, the dielectric constant, the wavelength of optical absorption or fluorescence bands and the electric resistance of many solids and fluids, and these phenomena are therefore used to measure pressure.

One must keep in mind, though, that all pressure transducers and gages have to be calibrated against suitable standards, which in turn must be traceable to the pressure scale established at the National Bureau of Standards. □

Next month Heydemann will discuss the pressure calibration services offered by NBS.

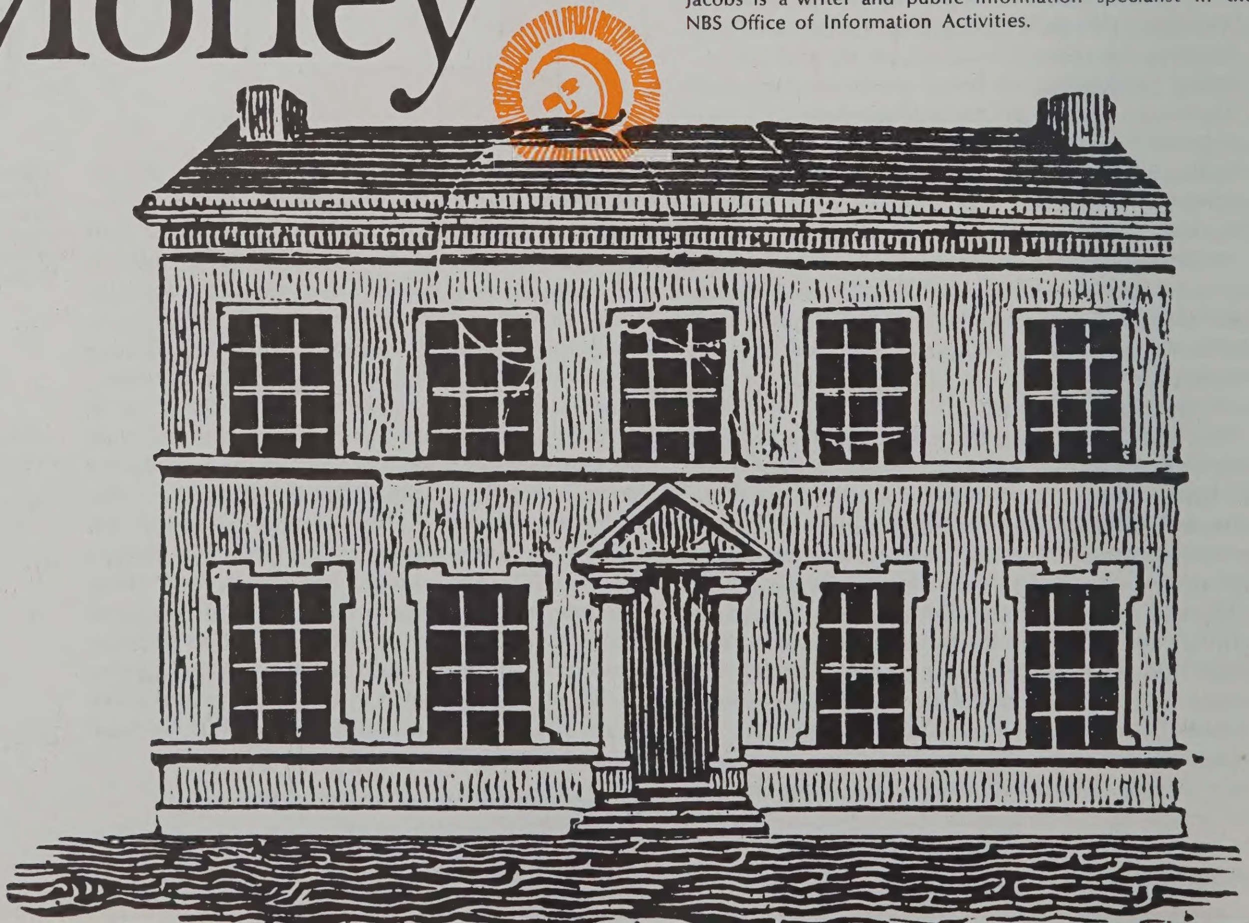
Summer Tips for Saving Energy and Money

by *Madeleine Jacobs*

WOULD you like to cut your utility bills? The National Bureau of Standards has compiled the following list of tips to help homeowners save energy and stay comfortable this summer. These suggestions are simple and can often be applied at little cost or no cost. Their effectiveness has been demonstrated by NBS through long experience in the field of building research and, more recently, through studies of the energy efficiency of home appliances.

Research at the National Bureau of Standards and elsewhere shows that some of the most important steps homeowners can take to save energy and stay comfortable during the summer months are reducing heat gain through the ceiling, reducing internal heat generation in the house, shading windows from solar radiation, and using whole-house fans to take advantage of natural temperature cycles and to provide ventilation. Turning up the thermostat on air conditioners is also important. Other tips on this list will help save energy and provide comfort as well.

Jacobs is a writer and public information specialist in the NBS Office of Information Activities.



1. Insulate the house. Many homeowners don't realize it, but insulation is a good investment for saving money on air conditioning bills as well as heating expenses. In addition to insulation in attics, insulation around air conditioning ducts in the attic is important and can save much energy and money for the homeowner. (Be sure to check for air leaks in ducts before insulating—as much as 10 percent of the energy used to air condition can be wasted through such leaks.) An NBS consumer guide, *Making the Most of your Energy Dollars in Home Heating and Cooling,* is available to help homeowners make the best investment in energy conservation improvements for their climate and the price of energy they use to heat and cool their houses. It is available for 70 cents a copy from Consumer Information Center, Pueblo, Colorado 81009.

①

2. Reduce heat gain from the attic. When the roof is heated by the sun, an attic can be as much as 22 °C (about 40 °F) hotter than the temperature of outside air. Adequate insulation in the attic floor is necessary. Consider increasing this insulation. Adequate ventilation is also important. A good rule of thumb is to provide 930 square centimeters (1 sq. ft.) of vent opening for each 28 square meters (300 sq. ft.) of attic floor area. Be sure there are adequate screened vents in soffits and gables or near the ridge. Consider ridge vents, turbine vents, and powered attic fans to further cool the air.

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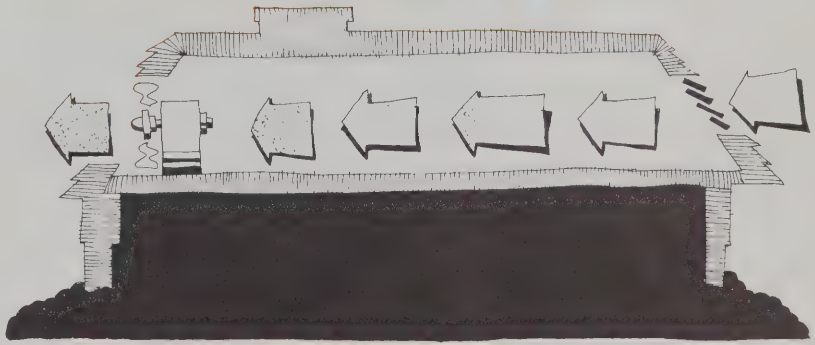

3. If the house does not have air conditioning, take advantage of the daily temperature cycle. Open windows and draw cooler night air into the house and shut them during the hot part of the day. When ventilating, draw in air from the coolest side of the house. Investigate the possibility of installing a whole house fan in the attic to pull fresh air throughout the house. A whole house fan is useful even in a house that has air conditioning; instead of using the air conditioner, use the fan (for indoor temperatures as high as 27 °C—about 80 °F). The increased air movement from the fan makes higher temperatures seem comfortable. Use small, quiet circulating fans to provide local air movement.

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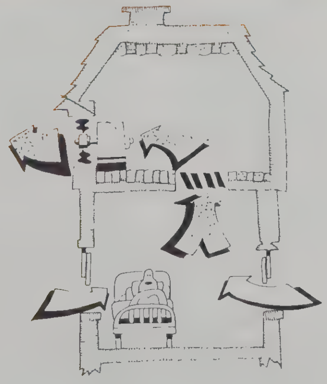

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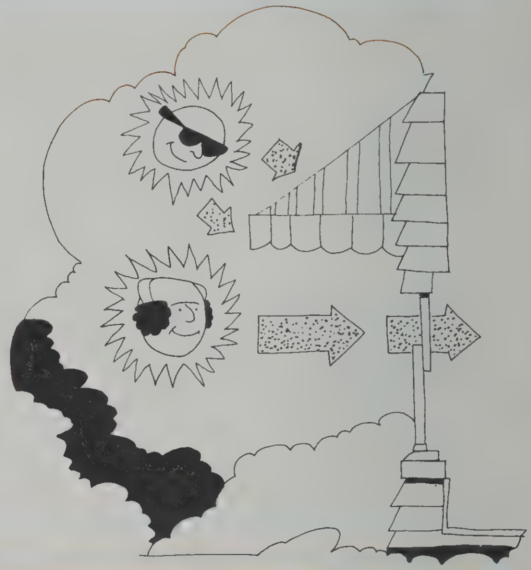
4. Shade windows, especially from direct sunlight.
   - Blinds and draperies can reduce heat gain through windows by as much as 50 percent, but their effectiveness depends on how well they reflect solar radiation back through the window. Blinds and draperies should be light in color and opaque. Open-weave draperies are less effective—but do allow good ventilation.
   - Special heat absorbing and reflecting glasses can reduce solar heat through windows by 40 to 70 percent. These glasses have the advantage of doing the job while not interfering appreciably with the view.
   - Awnings and overhangs are the most effective way to reduce solar heat gain through windows. They must be properly designed, however, in order to prevent hot air from being trapped in the window area.



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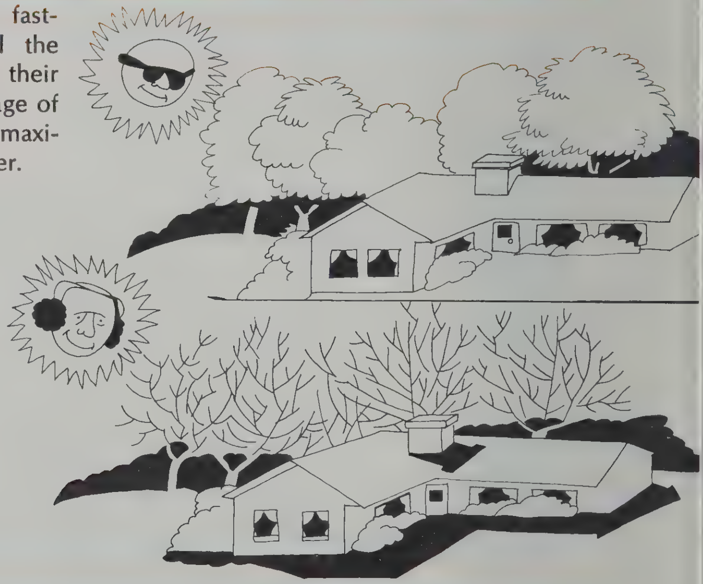
5. Shade house from sun by planting fast-growing trees or large shrubs around the home. Deciduous trees (those that lose their leaves in winter) have the special advantage of providing summer shade and allowing maximum exposure to the sun in cold weather.



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6. In houses with central air conditioning, set thermostats at 26 °C (that's around 79 °F.) Turning up the thermostat to this temperature, rather than 23 °C (around 73 °F), can mean a substantial energy savings. The exact energy savings depend on the geographical location, but for every 2 °F (about 1 °C) that the thermostat is turned up, energy savings of 18 percent or more can be achieved.

7

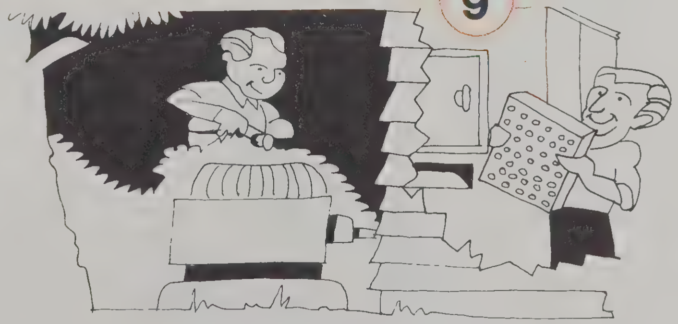
7. When shopping for a room air conditioner, try to select one with the required cooling capacity for the room. If the cooling capacity of a room air conditioner is too small for the room where it will be used, it will not do an adequate job of cooling and dehumidifying. If it is too large for the room, it will probably be more expensive to purchase and it may not dehumidify efficiently. Dealers should be able to give advice concerning the right size air conditioner unit to suit the purposes, taking into account such factors as the size of the area to be cooled, the number and sizes of windows, the direction they face, etc. For units of any given cooling capacity, buy the most energy efficient models. To compare efficiencies among different units, divide the cooling capacity in Btu's per hour by the power in watts that it uses. This gives the Energy Efficiency Ratio (EER). Look for units with the highest EER for a given size. Higher efficiency means less use of electricity and lower operating costs.

8

8. Central air conditioning systems generally provide the most effective and economical means of total house cooling. However, individual room units may be more economical, from the standpoint of both initial investment and operating cost, if air conditioning is required in only a few areas such as bedrooms. When considering the installation of central air conditioning, seek expert advice concerning the size of the air conditioner unit.

In planning to both insulate a house and purchase a central air conditioner, remember that after insulation, the home's heat load will be reduced. The central air conditioner can therefore have a smaller cooling capacity, which means a lower initial cost as well as a lower operating cost. (It is better to buy a slightly undersized unit than one that is oversized.)

9



9. Operate air conditioning equipment efficiently.
   - For individual or window units, if the circulating fan has more than one speed, run it at lower speeds in mild weather. Because most houses have enough natural air leakage for ventilation purposes, the outdoor air damper should be closed for greater effectiveness and economy; it can be opened to speed up removal of cooking or tobacco odors. Turn the unit off if rooms are unoccupied for several hours.
   - For central air conditioning systems, locate the thermostat control on an inside wall where comfort is of greatest importance, or in a hallway where it can sense air circulating from several rooms.
   - Check filters for dust or lint every 30 to 60 days and clean or replace as necessary. Allow free circulation around the condenser by keeping shrubbery trimmed.

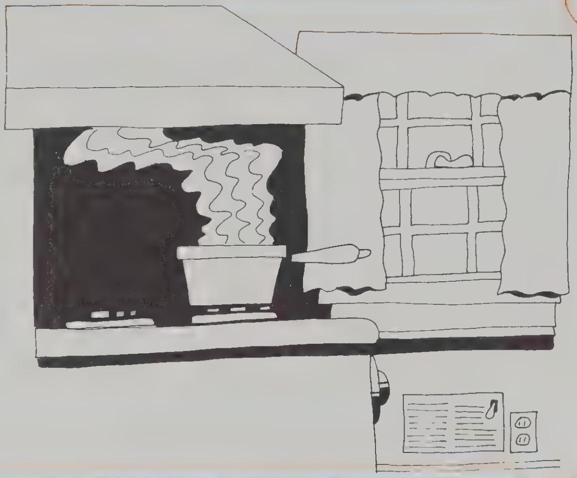
turn page

10

10. Reduce heat generation in the house by limiting use of electricity, gas, and other fuels, which generate heat and moisture. Overall, average heat generation (excluding heat given off by occupants) in a moderately sized household might be on the order of 63 000 kilojoules or 60 000 Btu per day or more. This internally generated heat and humidity add to the heat and humidity already in the house, making occupants uncomfortable. It also places an extra burden on the air conditioning system if it is on. By limiting use of appliances and lighting, homeowners can reduce the burden on their air conditioners. And since appliances cost money to operate, they are also cutting down on operating costs as well —a double benefit. Several relatively easy steps can be taken:

- Turn off lights when not needed, especially high wattage lights used for sewing, study, hobbies, etc. Use daylighting (not direct sunlight) from windows whenever practical and use lighter colors on interior wall surfaces to reflect natural daylight from outside. Use the most efficient and practical light sources. Fluorescent tubes produce more light than incandescent lamps, for a given amount of electricity consumed, and they therefore generate less heat. It is not a good idea, however, from an economic point of view, to turn fluorescent lights off and then on again if you leave the lighted area for only very brief periods of time (up to 10 minutes or so). Repeated starting of fluorescent tubes shortens their lifespan.
- Turn off television sets, radios, and phonographs when they are not being used. Limit use of electric irons, hair dryers, and other electrical appliances.
- Make sure that refrigerator or freezer door seals are air tight and that their condensing coils are clean for good air flow. Avoid unnecessary or prolonged door openings.
- Avoid using the cleaning feature of self-cleaning ovens at times when air conditioning loads are heavy. Operate self-cleaning feature late at night or early in the day, when demand on electrical utility systems is lowest.
- Try to confine heavy use of cooking ranges and shower facilities to the cooler morning or evening hours. When cooking, cook several dishes or whole meals in the oven at the same time to limit use of oven. Use cooking pots of the same diameter as the stove burner or heating coil. Use covered pots and low fires whenever possible, especially when boiling. Not only is this more efficient from an energy point of view, but it prevents unwanted heat from escaping into the kitchen. Keep oven doors closed when cooking and check seal of oven gaskets to make sure that heat is not leaking into the room from the oven.

11. If there is a large generation of water vapor or heat due to cooking, bathing, or washing, operate kitchen or bathroom exhaust fans (if they are vented to the outside) rather than opening windows when the air conditioning is on. Close off rooms in which exhaust fans are used to prevent air conditioned air from being exhausted to the outside. Remember to turn off exhaust fans when the job is completed.



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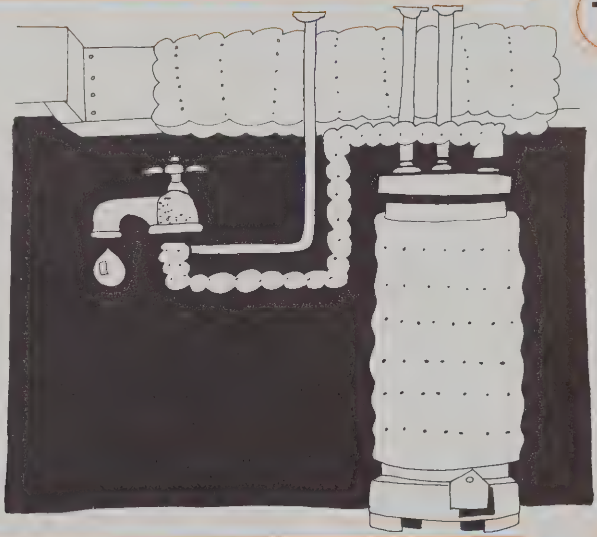
12. Insulate hot water storage tanks and bare pipes, which can give off heat and increase cooling requirements. Also consider reducing hot water temperature to 50°C (around 120°F). Check with a plumber to see whether this suggestion is practical.



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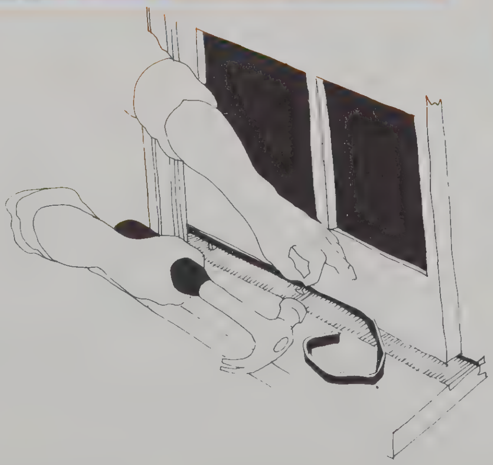
13. Prevent excessive entry of hot outdoor air. Weatherstrip windows and doors at moveable joints and caulk cracks and openings at their frames. Seal all cracks and openings in exterior walls.



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⑭

14. Use light colored paints and roofing materials. A dark colored exterior surface may get as much as 33 °C (about 60 °F) hotter than the air temperature in direct sunshine, while the same surface, painted white, would only be about 11 °C (about 20 °F) above the air temperature. It is especially desirable to have the roof color as light as possible—a point to remember when planning to replace an old roof or when building a new house.

⑮

15. Close and seal all openings into the attic from occupied space, including cracks around attic doors.

⑯

16. Close off rooms and closets not in use.

⑰

17. Keep windows and doors shut and keep storm windows and doors in place when the air conditioning system is turned on.

⑱

18. If the house has a fireplace, close its damper.

⑲

19. If an addition to the house is being made, try to orient the rooms and windows to take best advantage of prevailing wind conditions and sun orientation. In general, a north-south orientation of windows is best, especially if some shading devices—either trees or overhangs—can be used on south facing windows.

⑳

20. Remember to take advantage of nature, even if the house has central air conditioning. It is possible to maintain a comfortable house in summer in many parts of the United States without relying on an air conditioning system. In fact, many people do. Take advantage of daily temperature cycles (see tip 3), using the night air to cool the house. The lowest air temperature usually occurs from midnight to just before dawn. In dry climates, evaporative cooling devices, which evaporate water to lower the temperature of a stream of outdoor air circulated through the house, can provide comfortable conditions both day and night at low cost. □

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By Frederick P. McGehan

IT is a common consumer headache.

The six-month-old television set breaks down so the owner goes to the warranty book. The company will pay for the cost of repair—provided the customer brings the machine into the authorized service center. Otherwise, the owner must pay to have a repairman make a house call. So, the owner struggles to transport the extremely heavy machine into the repair center.

Why should the consumer have to sustain back pain to lug the heavy appliance from house to car to service center—and home again when the machine is fixed? Because under the terms of the product's warranty, it is considered a "portable" object, although it may require two persons to carry it.

A helping hand is on the way. The Federal Trade Commission has become interested in the question: How portable is portable? To assist in answering this question, the FTC has drawn on the technical resources of the National Bureau of Standards.

To assist it in establishing criteria for portability, the FTC came to NBS' Center for Consumer Product Technology. The Center's Human Factors Section performed two major tasks for the FTC: a literature review of product portability and a controlled study involving simulated consumer products with volunteers from the NBS staff as participants.

The stimulus for this interest was the Magnuson-Moss Warranty Act of 1975, which required the FTC to promulgate rules for full and limited consumer

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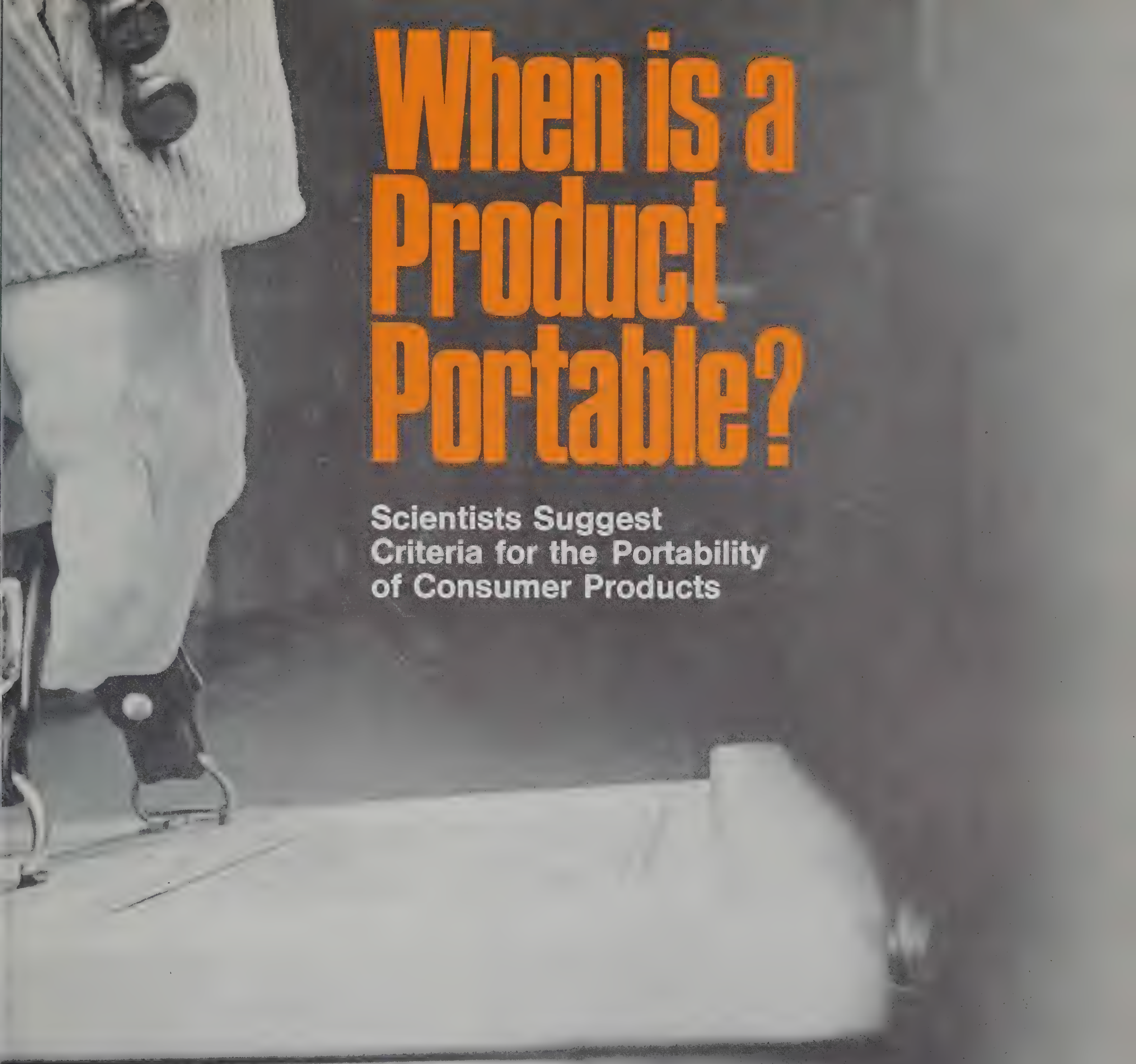
McGehan is a writer and public information specialist in the NBS Office of Information Activities.



When is a Product Portable?

Scientists Suggest Criteria for the Portability of Consumer Products

product warranties. The FTC was interested in knowing under what conditions it would be reasonable to impose on the consumer the task of returning the product for service. The agency wanted to establish maximum reasonable weight limits for a consumer product return activity. It asked NBS to generate a data base which would be useful in the development of portability regulations.

Joel J. Kramer and Patrick G. Meguire of the NBS Human Factors Section identified between 600 and 700 references of possible relevance in the first phase of their literature search. This led to a more comprehensive review of 104 articles, none of which dealt specifically with the problem of portability as it related to return of consumer products for servicing. While maximum acceptable weights for lifting and carrying were identified for industrial workers, the researchers found these criteria unacceptable for a broader population base.

"No definitive recommendations concerning absolute product weight and size limitations for consumer product return activities can be made based on the . . . literature review," they concluded.

For the second phase of their study, Kramer and Meguire asked for volunteers among the 3,000 persons who work at NBS' Gaithersburg, Md., headquarters. They selected 69 persons of varying age, sex, height, and weight distributions for participation. The researchers were interested in measuring the differences in maximum reasonable weight as a function of sex, age, the method by which the product is handled, and the size of the product.

For purposes of the study, they considered a

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For purposes of the study, researchers consider a product portable if it can be lifted and carried by most consumers a distance of at least one city block without excessive strain, exhaustion, or use of aids.

product portable "if it can be lifted and carried by most consumers a distance of at least one city block without excessive strain or exhaustion and without the use of external aids." External aids would be dollies, carts, or similar devices.

Two wooden boxes were used to simulate consumer products in the test. One was a 38.1 cm cube and the other was a 30.5 cm cube. Each box had a strap handle at the top. The sizes were characteristic of many compact consumer products such as television sets, sewing machines, and microwave ovens.

Smaller boxes were set inside the larger cubes, enabling the participants to vary the weight of the simulated consumer product by either adding or removing lead shot.

Participant in portability study adjusts the weight of a simulated consumer product by pouring lead shot into the box.

Participants were asked to attend two sessions, the first one lasting about 45 minutes and the second one 30 minutes. Their first task was to adjust the weight of the two simulated consumer products to a value that the participant thought would be the maximum reasonable weight he or she would be willing to carry in a product-return situation. After completing this, the participants were asked to lift and carry the simulated product through a marked-out course to verify his or her judgment of maximum reasonable weight.

The carrying distance was 122 meters, or about one city block. Participants were required to open a closed door and carry the "product" up one flight of stairs. "This distance was selected to represent a worst-case condition distance-wise," the NBS researchers stated in their final report. Participants were allowed to stop and rest as often as they liked and were permitted to walk at their own preferred pace.

The researchers found that the sex of the participant and the method used to carry the product were more important in determining the maximum reasonable weight than the age of the participant or the size of the object (for the sizes chosen for study). The fact that age did not have a significant effect was the "biggest surprise," Kramer said.

"Our test situation was such that whether you parked near the store or a block away, you were free to choose how you were going to do the task, how long you were going to take, and how long you wanted to rest. Under this freedom of choice, we found that people who are older merely go more slowly and take more rests," he noted. Ages of the participants ranged from 16 to 65 years.

As might be expected, the maximum reasonable product weight for females was less than that for males. The mean maximum reasonable weight for males was 20.4 kilograms; for females it was 14.2 kg. When the weight variations were combined for the methods of carry (one-handed versus two-handed) and for both sexes, 9.4 kg did not exceed the maximum reasonable weight for 95 percent of all participants, 90 percent accepted 10.7 kg, 75 percent accepted 13.0 kg, and 50 percent accepted 16.6 kg.

The researchers discovered that the handles on the tops of the boxes added little to the amount of weight the person could carry comfortably. It was more of a convenience in that the participant did not have to stoop to adopt a two-handed carrying position.

Kramer and Meguire suggested that the "absolute limits for product weight should be on the order of 10.7 kg to satisfy 90 percent of the consumer population." Limits for maximum acceptable size should be between 30.5 cm^3 and 38.1 cm^3 for "compact products of roughly cubical dimensions . . . to satisfy approximately 90 percent of the consumer population," they added.

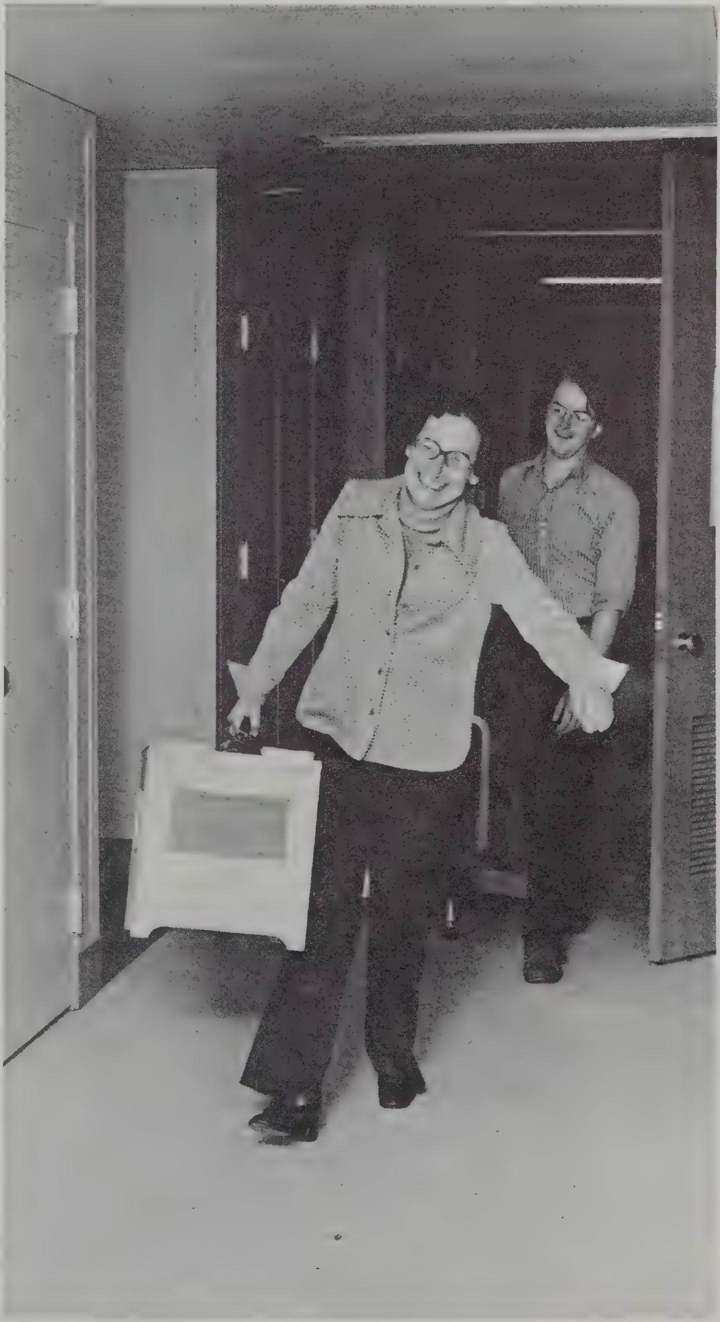
NBS is continuing to work on the portability issue, trying to devise an index (a numerical scale) whereby products could be rated for portability. The higher the number, the more portable the product would be. The index value could be attached, possibly on a tag or label, to the product so the consumer would have such information available at the point of sale.

As an example, a consumer may be in the market for a 19-inch television set and may want one that he can carry from room to room with ease. A portability index number on each set would give him this information at a glance. Kramer believes the index may also aid the manufacturer in designing safer and more useful products.

Kramer hopes to have a "first generation" index completed by the end of September. It may conceivably become part of the new Department of Commerce program for voluntary labeling of consumer products on the basis of performance.

As the result of NBS research, the cure for at least one consumer headache may be a number and not an aspirin. ☐

Bottom left. A volunteer has completed pouring the lead shot and is now getting a feel for what the "product" is like. She is trying to determine whether she has a maximum reasonable weight for a product-return activity.



Right. As the participant carries the "product" the length of a city block, Patrick G. Meguire, principal investigator on the project, walks behind to observe and offer safety assistance if necessary.

Age did not have a significant effect in determining what an individual decided was a maximum reasonable weight to carry.

ON LINE WITH INDUSTRY

THE KEY TO MARKETING NEW ENERGY-RELATED INVENTIONS

by Diedra Van Duzee

Environmetrics, Inc., in Pittsburgh, Pennsylvania, recently marketed a new device, an electric meter for utility companies. With this invention, power companies can change their rates in an instant. For example, they can raise rates when demand for power is great and lower them when demand is small. Importantly, consumers can monitor these rate changes on the meters in their homes.

The aim is to distribute energy use more evenly over 24 hours, thus avoiding periods of peak demand that overtax a power system. Consumers can save money by using appliances and other energy-consuming equipment during the hours when rates are down. Power companies can save energy by increasing the efficiency of their operations.

Murray Lowenthal of Environmetrics, the man who invented the new meter, credits the National Bureau of Standards with providing ". . . the key that enabled us to finance and market our idea." The "key" mentioned by Lowenthal was an evaluation of the technical and economic potential of the idea performed by the NBS Office of Energy-Related Inventions. On the basis of the evaluation, NBS recommended government support for developing the invention.

Environmetrics is one of more than 5,000 small businesses and individuals that have submitted ideas to NBS related to conserving or increasing the supply of energy. Under the Federal Nonnuclear Energy Research and Development Act of 1974, the Bureau is authorized to evaluate these proposals and to recommend promising inventions to the Energy Research and Development Administration (ERDA).

Van Duzee is a staff writer for DIMENSIONS.

The purpose of the NBS office is to carry out such evaluations, particularly on those inventions proposed by individuals and small businesses, so that no significant energy-related idea is overlooked.

George Lewett, head of the office, says "We hope NBS will be involved in a major energy-saving breakthrough. We have a positive attitude, and we cannot afford to miss a valuable invention. If we have to err, we would rather it be in the direction of calling a poor invention good rather than the reverse."

If NBS decides an idea has merit, it passes along its recommendation to ERDA. About 2 out of every 100 inventions submitted to the Bureau are sent on. If the NBS recommendation is accepted, ERDA determines the nature and extent of support for the invention based on the individual case. Support could consist of financial or other forms of assistance for developing or testing a prototype.*

The NBS program is a free service to inventors. It saves businesses and individuals what they cannot afford to lose—time and money. Furthermore, it is designed to minimize red tape, provide unbiased evaluations, and protect the secrecy of submitted ideas.

The procedure is essentially a "paper process." That is, an inventor submits a written description of an invention rather than a model, and no tests are conducted by NBS personnel. Only one form is involved, and the procedure is similar to submitting a contract proposal.

Although an invention need not be patented or patentable to be submitted to the program, 80 percent of those received either have been patented or are being considered under the patent process. The subject matter of the inventions ranges from new internal combustion engineer designs to new structural materials and industrial chemical process improvements. More than half address energy conservation activities, and about 1 in every 5 relates to solar energy.

Each idea is reviewed independently by at least two engineers or scientists. If it looks promising, an in-depth evaluation is performed under a contract to NBS by qualified firms or individuals outside government. Any evaluator who might have a conflict of interest in handling a proposal is expected to disqualify himself and is required to agree in writing that he will do so.

To maintain the secrecy of ideas, evaluators are held accountable for each invention handled. Criminal penalties can be imposed for unauthorized release of confidential data.

Evaluators address the following questions:

- Will the invention operate as the inventor claims; and
- What are the chances that its transfer to the marketplace is economically feasible?

Lowenthal of Environmetrics claims the system works. "This could be the future of a great many innovations that Americans dream about but don't know how to bring to fruition, he says.

And he is not alone in his assessment. Herb Seaton of Piranha Products in San Diego is another satisfied Bureau client. He says, "It is a good program. It separates those inventions that have a solid technological base from those that are on technological quicksand."

Piranha is now marketing its NBS-evaluated invention, a food-waste disposal powered hydraulically by the water it uses rather than by electricity.

Persons interested in trying the system for themselves by submitting an invention should write to the Office of Energy-Related Inventions, National Bureau of Standards, Washington, D.C. 20234, or call 301/921-3694. Ask for the evaluation request form (NBS Form 1019).

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*To date, ERDA has accepted some 80% of the NBS recommendations. ERDA is not compelled to accept all NBS recommendations, and its own evaluations include programmatic and other non technical considerations. For example, the two cited in this article—the Environmetrics Meter and the Piranha Disposal—received no support from ERDA. However, many inventors agree with Lowenthal that the NBS recommendation itself is a key to obtaining financing.

STANDARDSTATUS

AN INTERNATIONAL STANDARDS CODE FOR PRODUCTS

by Samuel E. Chappell

Shoes and TV sets are commodities we are all sensitive to in the marketplace, and many of us have become aware that significant quantities of these products are imported. Recently, the United States' government assessed the possible injury to our own domestic industries caused by these particular imports. Actions were taken to determine whether something needed to be done to remedy the situation, and by agreement with some of the affected importing nations, Americans will be seeing fewer foreign-made shoes and televisions on the U.S. market over the next few years.

In view of the rather poor economic health that has existed worldwide since the advent of the energy crisis, such trade issues are bringing forth appeals from some sectors within this and other nations for "protectionist" rather than "free-trade" policies. Others believe that establishing more restrictive trade barriers now can lead in the long run to an even worse overall world economic condition.

Some eighty nations, including the United States, are involved in the Multilateral Trade Negotiations (MTN), a working group whose goal is to achieve as liberal a basis of international trade as is practical. The MTN is a forum where nations develop agreements that maximize trading opportunities and minimize difficulties for domestic industries in the participatng countries. The Office of the Special Representative for Trade Negotiations represents the United States in these international deliberations.

Establishing and maintaining an equitable basis for trade must be a continuing process. The MTN is such a process today, as it has been since 1947 when the General Agreement on Tariffs and Trade (GATT) was established. The MTN operates under the auspices of the GATT. Seven rounds of negotiations have been conducted, and the current session, called the Tokyo Round, began in 1973.

One important issue in the Tokyo Round is the development of a standards code for products traded internationally. The code, which was introduced in 1975 and is still being worked on, specifies procedures for nations to follow in adopting product standards. These procedures are meant to eliminate the use of standards as a means of discriminating against imported products, to encourage the use of international standards in domestic technical regulations and certification systems for products, when appropriate, and to promote the use of open procedures in developing all product standards. The draft code also covers packaging and labeling regulations. Negotiations are well advanced, but some major issues remain unsettled, including international enforcement and "special and differential treatment" for developing countries.

Activity is already underway to assess the impact of the standards code, if adopted, on various sectors that would be affected within the United States. Such information will be of vital importance as background in drafting implementing legislation for approval by Congress. The potential impact of the code on the private sector has been assessed by the American National Standards Institute (ANSI) under contract with the Office of Product Standards of the Office of the Assistant Secretary for Science and Technology in the Department of Commerce. A report by ANSI to DoC on this study is now available. The Interagency Committee on Standards Policy (ICSP) is sponsoring a similar study concerning the standardization activities of federal agencies. Finally, plans are being made to assess the potential impact of the code on state and local governments. If the United States were to adopt the code, the federal government would be required to "use all reasonable means" within its power to ensure compliance of regulatory, standardization, and certification bodies in state and local governments as well as voluntary standards and certification organizations in the private sector.

NBS has participated actively in these assessments and will continue to make technical assistance available on matters concerning future negotiation and implementation of the code.

Dr. Chappell is programs coordinator in the NBS Office of the Associate Director for Information Programs. Last month he completed a year-long assignment with the U.S. Office of the Special Representative for Trade Negotiations under the Commerce Department's Science and Technology Fellowship Program.

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SINGLE-CRYSTAL METHOD FOR IDENTIFYING CRYSTALLINE MATERIALS

Unknown substances of a crystalline nature may now be identified on a routine basis in industrial laboratories. The technique that makes this possible has been developed by NBS in conjunction with an industrial analytical instrument company. The new method can be used to identify the crystalline constituents of any organic or inorganic material, for example, drugs, minerals, poisons, pesticides, antibiotics, and pollutants.

Alan D. Mighell, Inorganic Materials Division, B222 Materials Building, 301/921-2950.

Using x-ray diffraction, one can determine unit cell parameters from a single crystal of an unknown material. The unit cell is the "building block" of crystalline matter; that is, it is the smallest portion of matter that, when repeated in three dimensions to form a crystalline lattice, defines the atomic arrangement of a substance. A primitive unit cell is the simplest cell with the smallest cell volume that can be used to characterize or define a lattice; of the many different primitive cells that may equally well characterize a lattice, the reduced cell is the cell that is mathematically unique.

Cell parameters are like a fingerprint and can be used to identify the material. Nevertheless, single-crystal x-ray diffraction methods have been mainly confined to the academic laboratory because of the rather complex procedure necessary to determine the cell parameters of an unknown. The situation has now changed. Several recent developments make the single-crystal method very attractive for routine industrial use. These include: growth of the data base, advances in lattice theory, and the use of automation to determine cell parameters. Because of these advances, it is now possible to identify an unknown single crystal by mounting it on an automated x-ray diffractometer, determining a primitive cell, reducing the cell, and checking against a file of reduced cells. The entire procedure can be automated. A summary of the identification procedure is outlined in figure 1.

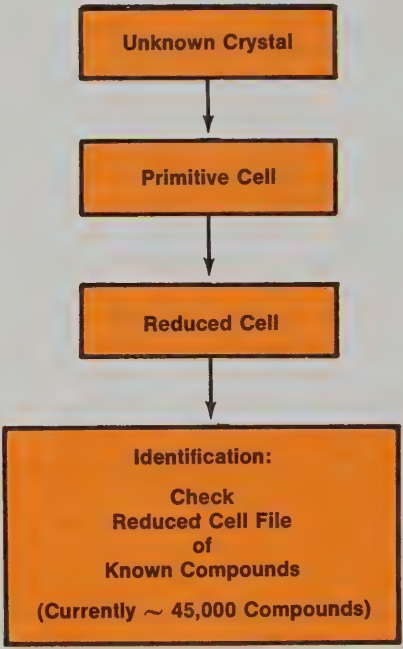
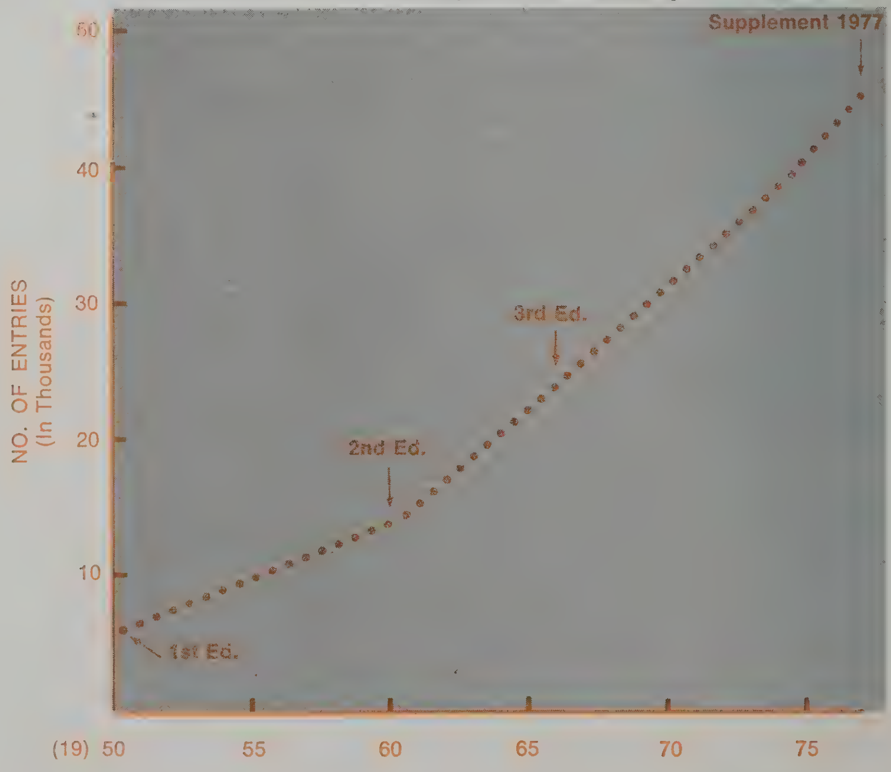


Figure 1—Crystallochemical Identification Procedure

As indicated above, three separate lines of development must merge for a successful identification technique: the data base, theory, and automation. The first two are being worked on at NBS and the third by Syntex Analytical Instruments, Inc. in cooperation with the NBS Institute for Materials Research.

The first line of development is the data base. During the past decade, entries for the crystal-data file (first started at Johns Hopkins University by J. D. H. Donnay) have been extracted from the literature and critically evaluated at NBS and at Cambridge University, England. This work has been supported by the NBS Office of Standard Reference Data. Figure 2 shows that the data base is large and rapidly expanding. The arrows indicate when the first, second, and third editions of Crystal Data* were published. When the Supplement to the third edition is

Figure 2—Growth of Crystal Data File



completed, a total of ~45,000 materials will have been abstracted and evaluated.

In the second line of development, the field of lattices, studies have been carried out (in the NBS Crystallography Section in collaboration with A. Santoro of the Reactor Division) on reduction theory and procedures, on derivative lattices, and in lattice symmetry. By using derivative lattice theory, one can devise algorithms to assist in the determination of a primitive cell of the lattice; by applying reduction theory, one can transform any cell to a "unique" primitive cell suitable for identification; by analyzing the relationships of the reduced cell parameters, one can determine the lattice symmetry from the reduced form. NBS is reformatting the crystal-data file so that identification can be made using this reduced cell.

The third line of development is crucial and it involves the use of a single-crystal diffractometer for the determination of a unit cell of an unknown substance. This cell can then be checked against the data base for a match. To make this possible, Syntex is writing the required software for the diffractometer to obtain the refined reduced cell of the lattice. This new computer software is designed so the user of the diffractometer can quickly and routinely obtain from an unknown crystal the cell and symmetry data required for identification.

The data file against which the unknown is checked for a match can be stored in a number of ways. For example, crystal data can be stored in a book, in the memory of minicomputers, or in CIS (Chemical Information System developed by the National Institutes of Health and the Environmental Protection Agency). In CIS the crystal-data file will be linked to other major data bases. These data bases can then be accessed interactively by a desk top terminal. The book format and the minicomputer have the distinct advantage that the diffractometer that measures the unit cell and the data file are self-contained.

The single-crystal x-ray diffraction method can now complement other major techniques for characterization and for identification of crystalline materials. This method of identification is essentially nondestructive, requires only one small crystal (~0.1 mm in diameter), can be used to analyze an individual crystal selected from a mixture, and can be widely applied because of the extremely large number of materials in diverse areas that can be made to crystallize. These areas include the broad categories of inorganic, organic, and biological materials and many specialized areas such as minerals, intermetallics, drugs, steriods, poisons, pesticides, antibiotics, and pollutants.

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* Donnay, J. D. H., and Ondik, H. M., *Crystal Data Determinative Tables: Third Edition, Volumes 1 and 2*, U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. and the Joint Committee on Powder Diffraction Standards, Swarthmore, Pennsylvania (1972, 1973).

NBS STANDARD NEUTRON BEAMS EXTEND ENERGY RANGE FOR PERSONNEL DOSIMETER CALIBRATIONS

At the NBS reactor researchers have used filter techniques to produce neutron beams for dosimeter calibration at energies of 2 keV, 24 keV, and 144 keV. The 144-keV beam provides an overlap with existing calibration facilities, the 24-keV beam fixes the low-energy end of these facilities, and the 2-keV beam provides the only calibration point available in the intermediate energy range.

Robert B. Schwartz and Ivan G. Schroder, Center for Radiation Research, Room A-153 Reactor Building 301/921-2421.

In the field of neutron personnel dosimetry, the energy range between about 1 eV and 30 keV is sometimes called the "neglected energy range." The "neglect" refers to the fact that dosimeters are rarely calibrated in this range. This neglect does not arise from any lack of interest

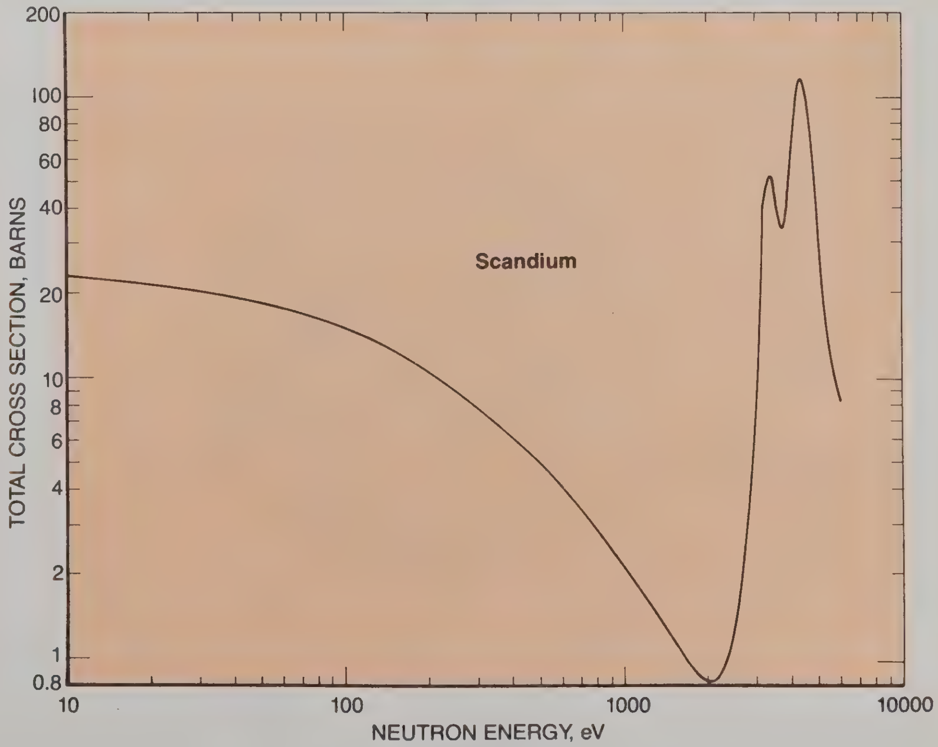

Figure 1—Total Neutron Cross Section of Scandium from 10 eV to 8 keV. *The minimum at 2 keV is responsible for scandium functioning as a filter. Other minima at higher energies are not shown.*

turn page

or importance; indeed, typically ⅓ to ½ of the neutron dose in the working environment around a nuclear reactor is due to neutrons in this intermediate energy range. The neglect is rather due to the fact that it is very difficult to produce useful monoenergetic neutron fluxes of these energies, and hence good calibration facilities simply do not exist.

At the NBS reactor, we have used filter techniques to produce high intensity neutron beams with energies of 2 keV, 24 keV, and 144 keV. The 2-keV beam provides a calibration point more than one decade lower in energy than had been available previously, and thus opens up the neglected energy range. The 24-keV and 144-keV beams provide convenient tie points with other more conventional, facilities.

Neutron filtering occurs at energies where there are deep minima in the neutron total cross section, caused by interference between resonant and potential scattering. In the specific case of the 2-keV beam, the minimum (or "window") is in scandium: the scandium cross section in the vicinity of the window is shown in figure 1. An appropriate thickness of scandium (in this case, approximately 1 m) will have a relatively high transmission for neutrons whose energies correspond to the minimum (i.e., $\sim$ 2 keV), but will strongly attenuate neutrons of other energies, thus producing a beam of 2-keV neutrons.

Unfortunately, there are also several other windows in scandium at higher energies, not shown in figure 1. These windows could result in a relatively high transmitted neutron flux in the energy range between about 8 keV and 800 keV, and these higher energy neutrons would then form an unwanted background to the desired 2-keV beam. In some of the earlier work with 2-keV filtered beams at other installations, this high energy background flux was equal to as much as ⅔ of the 2-keV flux. The *dose* due to these neutrons was then several times higher than the dose due to the 2-keV neutrons making the facility quite useless for dosimeter calibration. This problem is inevitable in any facility in which a scandium filter looks at a reactor core.

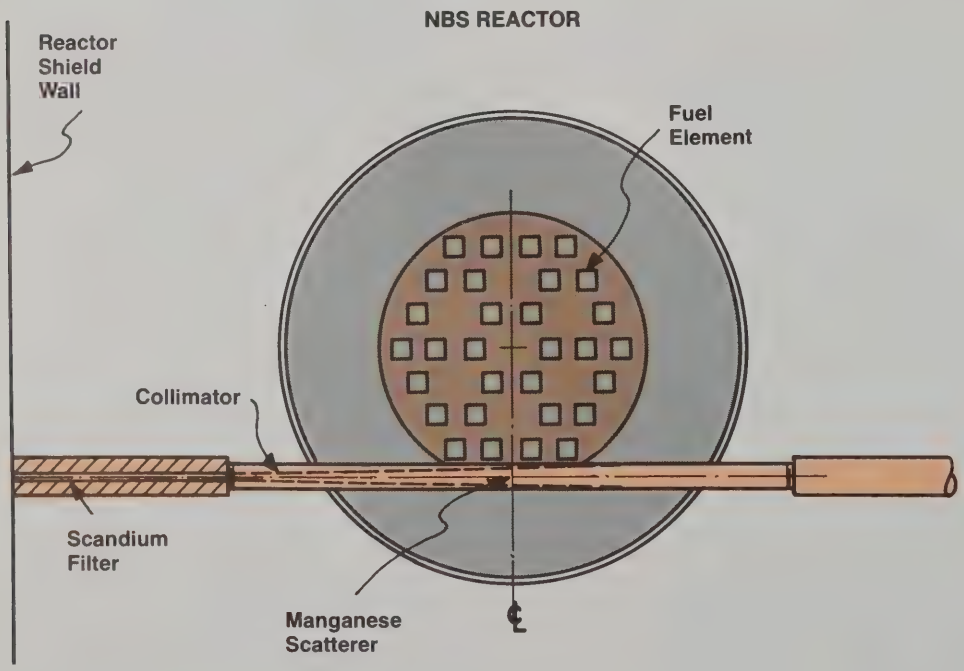

Figure 2—Schematic Representation of the NBS Reactor Showing the Filter, Collimator, and Scatterer in the Through Tube (not to scale).

This background is essentially eliminated in the NBS installation by using a reactor through tube in conjunction with a resonant scatterer. The through tube passes 10 cm outside of the edge of the reactor core, and the collimating system containing the filter sees only a scatterer at the center of the tube and not the reactor core itself. (See Fig. 2). We use a thin piece of manganese to scatter the neutrons, taking advantage of its very large scattering resonance near 2-keV energy. We thus preferentially scatter 2-keV neutrons through the 2-keV scandium window. Any other scattering resonances in manganese do not line up with the higher energy windows in scandium. This technique practically eliminates the unwanted higher energy neutrons (and also the gammas.) The advantage of this design may be seen in our measured neutron spectrum shown in figure 3, where the higher energy flux is only $\sim$ 3% of the 2-keV flux.

In addition to the 2-keV beam, we have produced a 24-keV beam by using an iron-aluminum filter, and a 144-keV beam using a silicon filter. For these two beams, we use graphite as a neutron scattering material, in the other reactor through tube. In these cases, we do not make use of any resonance properties of graphite, but choose it because it is a convenient low-Z material and hence minimizes the gamma ray contamination of the beams. In both of these beams, the "background" flux from other neutron energy groups is $\leq$ 3% of the flux at the nominal energy.

The beam intensities are measured with BF_3 or proton recoil proportional counters whose properties have been previously determined, and allow us to determine the beam intensities with an uncertainty of $<$ 10%.

The first extensive use of these beams for dosimeter calibrations was done by D. E. Hankins of Lawrence Livermore Laboratory (LLL). Some of his results are shown in Fig. 4. The circles are data obtained with the LLL cyclograph; the squares are the data taken with the NBS beams. While the ordinate is in arbitrary units, there has been no normalization between the data sets taken at the two labs. (The line is an eye-guide only.) We note that the data taken at 144 keV with our filtered beams are in agreement with the cyclograph data. This is particularly encouraging, since the two facilities are totally different, as are the techniques used for measuring the respective fluxes and doing the actual dosimeter calibrations. This good agreement gives some confidence in both systems. The 30-keV cyclograph data represent the practical low-energy limit of that device and the beam quality is somewhat suspect at this energy. Comparison of the 30-keV cyclograph and 25-keV NBS data for the 9-inch sphere remmeter suggests that the former point may be somewhat in error. The 2-keV NBS point then allows the calibration to be extended a decade lower in energy. The importance of this can be judged from the albedo dosimeter calibration curve: without the NBS 2-keV datum there would simply be no way of knowing the low energy response of the dosimeter.

It is clear that the neglected energy range need no longer be so badly neglected.

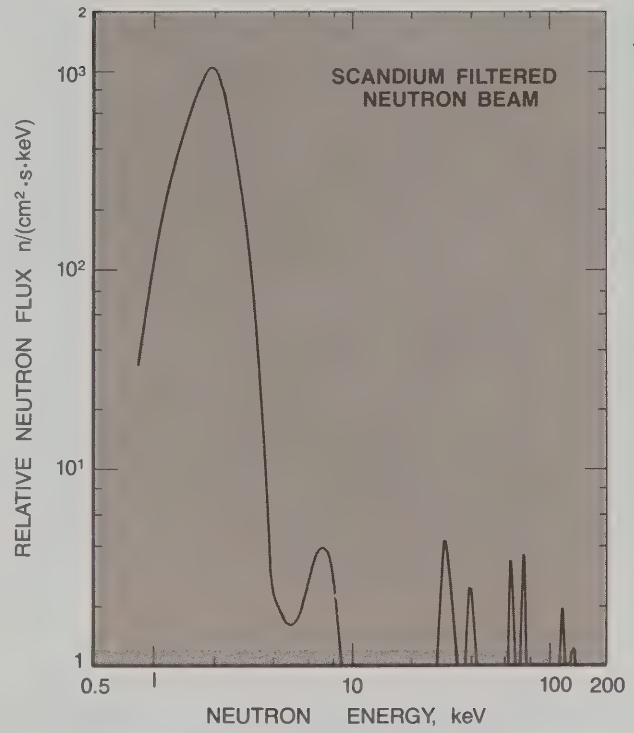

Figure 3—Neutron Spectrum Produced by Manganese Scatterer and Scandium Filter. *Approximately 97% of the flux is in the 2-keV peak.*

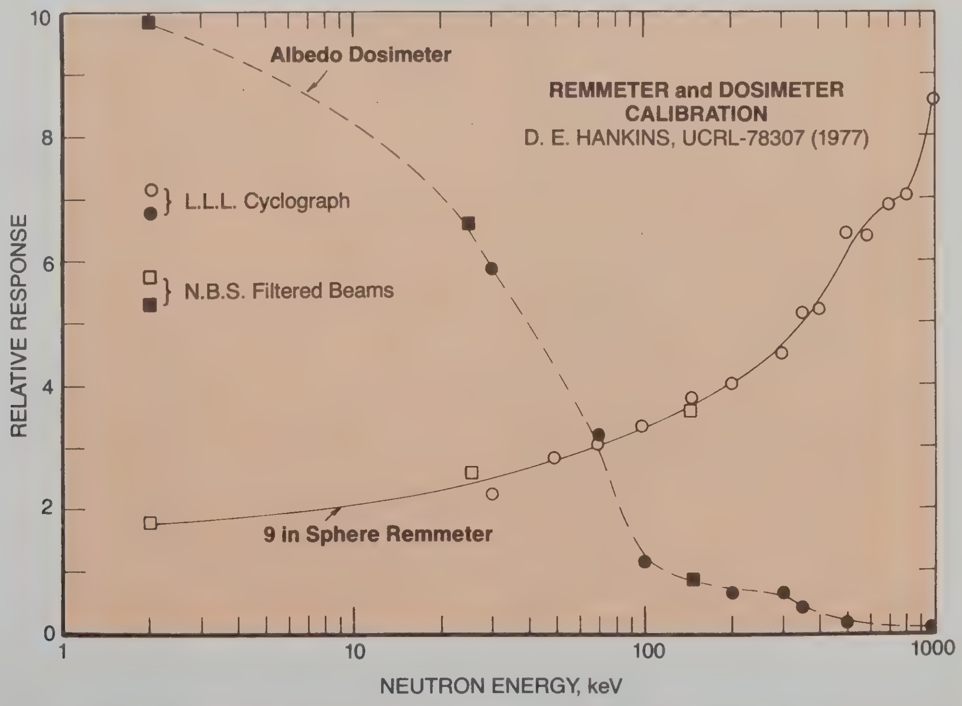

Figure 4—Energy Response of 9-inch Sphere Remmeter and of Albedo Dosimeter.

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NEW "PIEZO-FLEX" MICROPOSITIONING STAGE PERMITS SMOOTH CONTROL OF DISPLACEMENTS IN MICROSCOPE SYSTEMS

A micropositioning stage has been developed for use with optical and electron microscopes in the accurate measurement of microscopic objects such as biological cells, air pollution particles, asbestos fibers, the fine lines used in microcircuit devices, and micro-gap heads in tape recording equipment.

Fredric E. Scire, Mechanics Division, Rm. A22, Metrology Bldg., 301/921-2182.

Accurate measurement of microscopic objects, which are often less than one micrometer in size, requires that the object be moved slowly under what is essentially an extremely fine cross hair in the measuring instrument. A useful stage for this purpose must move extremely smoothly, be mechanically stable, and be electrically positionable so that it may be remotely activated and thus isolated from vibration and other environmental disturbances. Such stages have not previously been available.

The new PBS "Piezo-Flex" stage can be positioned to a precision of 0.001 micrometer (a distance corresponding to the width of a few atoms) over a range of 50 micrometers. A piezoelectric device converts the applied voltage into a stage displacement. By programming the applied voltage the stage may be moved in a smooth continuous motion as fast or as slow as the operator desires. Nonlinearity is less than ½ percent. All bearings and sliding components "pivot," thus eliminating all backlash. The lack of sliding members has eliminated the need for lubricants making this stage useful for high vacuum applications and for eliminating stick-slip friction and bearing "noise."

At first glance it would seem that the design of such a mechanical device, consisting of piezo expanders, levers, and flexure pivots, would be straight forward. Such is not the case when materials are highly stressed, where pivot "hinges" are so short that bending extends deeply into the lever arms themselves and where under these circumstances rigid steel arms "turn to rubber" on the micrometer scale. The execution of the "Piezo-Flex" stage design required the novel application of deformation equations to the stage's complex/strain distributions.

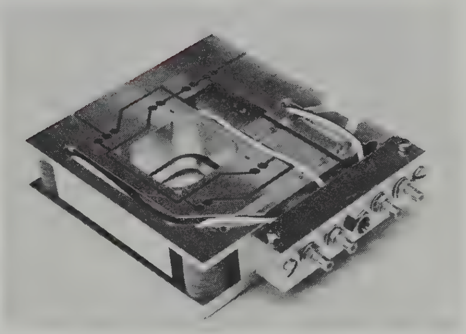


Figure 1—Shown Here Is the "Piezo-Flex" Stage for Use with Optical Microscopes. This particular design has the additional feature of focusing and leveling controls which are provided by three piezo-electric stacks, two of which are visible as vertical columns of stacked discs on the left side of the stage. Piezo-elements which produce the stage motion are located top center. Careful examination of the structure will show that there are two stages of lever amplification.

The device is presently being used in the Optics and Micrometrology Section for calibrating linewidths for the microcircuit industry and in evaluating surface finish measuring instrumentation. In the immediate future the stage will be applied to the problem of accurate measurement of standards for size measurement of air pollution particles in environmental applications, blood cells in medical diagnosis and treatment, and fibers for a host of new industrial products.

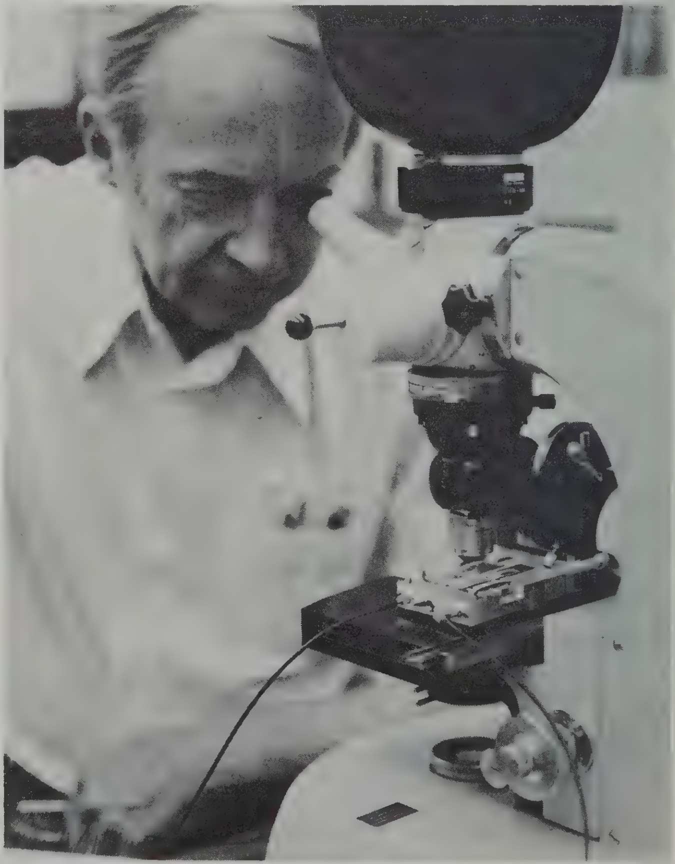


Figure 2—The Stage Is Being Used Here in the Measurement of Line Width Artifacts To Be Used by the Microelectronics Industry. The stage is being used to move the artifact through the field of view of the microscope.

IMPROVED HETERODYNE RECEIVER AT 300 GHz DEVELOPED

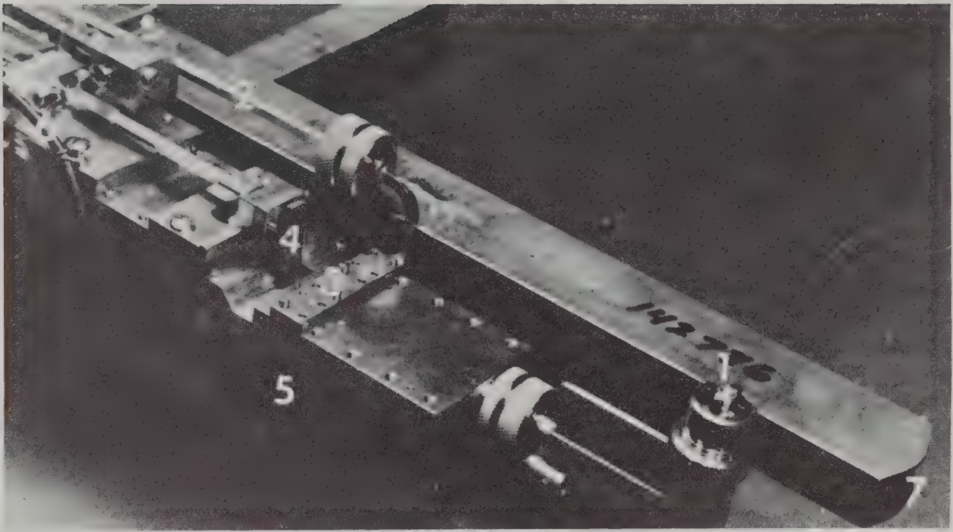
Superconductive electronic methods have intrinsic advantages in both bandwidth and noise level as compared with conventional electronics. These properties have previously been demonstrated for microwave receivers and magnetometers and researchers now have demonstrated improved capabilities in the millimeter wave region.

Donald B. Sullivan, Cryogenics Division, Room 20003C Building 2, Boulder, Colo., 303/499-1000 and Donald McDonald, Cryogenics Division, Room 2003A Building 2, 303/499-1000, in collaboration with Jochen Edrich of the Denver Research Institute.

In our present work, the receiver is tunable over the 200- to 325-GHz waveguide band, a frequency regime where component fabrication problems become severe due to small size (e.g., internal waveguide dimensions 0.43 x 0.86 mm).

The estimated noise temperature (single side band) of the system is 823 K with an instantaneous bandwidth of 20 MHz. The noise temperature represents an improvement by an order of magnitude over the best uncooled mixer receivers at this frequency and it is comparable to the noise performance of helium-cooled InSb bolometers which, however, are limited to a very narrow IF bandwidth (<2MHz). The most immediate application of these methods is to astrophysical observations of the line spectra of molecules.

The mixer is a point contact Josephson junction mounted in single mode waveguide. A 300 GHz backward wave oscillator is used as the local oscillator to produce a nominally 9 GHz IF signal which is amplified by a low noise ruby maser.



Figure—Josephson Mixer Mount of 300 GHz Receiver.

1. *Scalar horn*
2. *LO line*
3. *LO cross-guide coupler*
4. *RG 139 movable signal short lever*
5. *Josephson point contact adjustment rod*
6. *Bias cable for cooled multiplier*
7. *X-band slip fit waveguide leading to master tank*

NEW THERMODYNAMIC TABLES BEING PREPARED

NBS has signed an agreement with the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc (ASHRAE) to calculate and prepare tables of thermodynamic properties of moist air and of water at saturation in SI units for publication in ASHRAE's Handbook of Fundamentals

Arnold Wexler, Equation of State and Heat Division, A105 Physics Building, 301/921-2794.

The present tables for these properties, which were formulated almost three decades ago, have been used both in the United States and abroad as the basic input data for the analysis and design of heating, ventilating, air conditioning, and refrigerating equipment and systems. It is clear that advantage should be taken of the available fundamental constants, the current international practical temperature scale, newer data, better formulations of basic parameters, and the replacement of customary units of measurement by SI units in tables that are used internationally as a standard. It is expected that the resulting tables should be sufficiently accurate to satisfy any of the needs of the advancing state of the art in air-conditioning, humidity, meteorology and all other areas of utility for at least several decades.

The approach will be to examine critically the basis for the current formulations and, where necessary, to correct, modify or derive new relationships, to insert the latest evaluated values of experimental data and fundamental constants and to compute new values which will have the highest accuracy, completeness, and thermodynamic consistency, consonant with the present state of knowledge.

CONFERENCES

For general information on NBS conferences, contact Sara Torrence, NBS Office of Information Activities, Washington, D.C. 20234, 301/921-2721.

1977 COMBINED CRYOGENIC CONFERENCE

"Cryogenics—A Century of Progress, a Challenge for the Future" will be the theme of the 1977 combined Cryogenic Engineering Conference (CEC)—International Cryogenic Materials Conference (ICMC) to be held on August 2-5 at the National Bureau of Standards facilities in Boulder, Colo.

The combined conference is sponsored by the Cryogenic Engineering Conference Board and arranged by the NBS and the University of Colorado. It will emphasize recent developments as well as significant progress in cryogenics during the past one hundred years, according to Conference Chairman Michael J. Hiza of the NBS Boulder laboratories. Conference topics will include all aspects of developing technology of vital interest to the cryogenic community.

The CEC program will emphasize the broad categories of fundamentals, processes, and applications in such areas as refrigeration and liquefaction, superconductivity, liquefied natural gas, magnetic technology, food and health, energy, thermodynamics, and fluid mechanics. The ICMC program will emphasize material technology and material properties such as superconductors and their properties; structural and superconducting composites; structural metals, alloys, and polymers; containment materials; insulators; seals; and lubricants.

Attendees at the 1977 conference will elect three new members to fill expiring terms on the Cryogenic Engineering Conference Board. Candidates for the Board are nominated by petition of attendees of former Cryogenic Engineering Conferences for industrial, governmental, and educational organizations. The secretariat of the Cryogenic Engineering Conference is located at NBS in Boulder, Colo. (Dee Belsher, Conference Administrator).

With the cooperation of the CEC Board, the ICMC was successfully initiated in 1975, under the direction of Richard P. Reed and Alan F. Clark of NBS, with over 60 contributed papers. The edited papers of the 1975 CEC and ICMC were published as Volumes 21 and 22, respectively, of Advances in Cryogenic Engineering. The CEC Board arranged this parallel program with ICMC because of the many benefits in having conferences with mutual interests combined at one meeting time and place.

For further information on the 1977 CEC-ICMC, contact: Dr. Ronald W. Fast, Program Chairman, CEC, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Ill. 60510 and on the 1977 International Cryogenic Materials Conference contact: Dr. Richard P. Reed, Room 2-1226, Cryogenics Division, 303/499-1000, ext. 3870.

NCSL ANNUAL MEETING AT BOULDER, COLORADO

The National Conference of Standards Laboratories (NCSL) will hold its 16th annual meeting the week beginning August 7, 1977, in Boulder, Colo. Highlights of the meeting will be the workshops scheduled for Wednesday and Thursday, August 10 and 11, at the Broker Inn, 555 30th Street, in Boulder.

There will be approximately 10 workshops on topics of vital interest to calibration and standards laboratories including the reduction of National Bureau of Standards services; NCSL laboratory self-evaluation; metrology relating to Environmental Protection Agency, Underwriters Laboratories, Canadian Standards Association and Food and Drug Administration biomedical requirements; calibration systems management; test and measurement equipment specifications; and automation of calibration laboratories.

The workshop format gives participants a maximum opportunity to exchange practical ideas for improving present operations. They are open to nonmembers of NCSL as well as to members.

Summary reports of the workshop sessions will be presented Friday, August 12, in the auditorium of the Department of Commerce Radio Building at 325 Broadway in Boulder. Following the workshop reports, attendees can discuss measurement problems with NBS scientists who will be on hand for a "Meet the Scientists session" in the Radio Building. Friday afternoon there will be tours of the NBS Boulder laboratories.

The NCSL Board of Directors will meet in open session Monday and Tuesday preceeding the conference (August 7 and 8) in the Department of Commerce Radio Building.

NCSL, sponsord by NBS, is a nonprofit association of laboratories or organizations that maintain or have an interest related to measurement standards and calibration facilities. Each member organization appoints a "member delegate" who has the responsibility of representing the member company or organization in NCSL.

For further information on the NCSL annual meeting, contact either of the co-chairmen: Dean A. Brungart, Teledyne Systems Co., 19601 Nordhoff St., Northridge, CA 91324, 212/886-2211, ext. 2601; or James A. Valentino, Sanders Associates, Inc., 95 Canal St., Nashua, NH 03061, 603/885-2072.

General information is available from the NCSL Secretariat, Room 4001, Radio Building, NBS, Boulder, CO 80302.

CONFERENCE CALENDAR

***July 4-8**

THIRD INTERNATIONAL CONFERENCE ON LASER SPECTROSCOPY, Jackson Hole, Wyoming; sponsored by NBS; contact: John Hall, NBS, Boulder, Colo., 303/499-1000, ext. 3126.

***July 11-12**

ELECTROMAGNETIC INTERFERENCE WORKSHOP, NBS, Gaithersburg, MD; sponsored by NBS; contact: Walter Alspach, NBS, Boulder, Colo., 303/499-1000, x3285.

***August 2-5**

CRYOGENIC ENGINEERING CONFERENCE, University of Colorado, Boulder, Colo.; sponsored by NBS, the Cryogenics Engineering Conference Board and the University of Colorado; contact: Dee Belsher, NBS, Boulder, Colo., 303/499-1000, ext. 3981.

***August 22-26**

TIME AND FREQUENCY: STANDARDS, MEASUREMENTS, USAGE, NBS, Boulder, Colo.; sponsored by NBS; contact: Helmut Hellwig, NBS, Boulder, Colo., 303/299-1000, ext. 3277.

September 7-8

SEMINAR ON EARTHQUAKE DESIGN CRITERIA, STRUCTURAL PERFORMANCE, AND STRONG MOTION RECORDS, NBS, Gaithersburg, MD; sponsored by NBS, EERI; contact: Dr. Richard Wright, B244 Building Research Building, 301/921-3377.

September 21-23

SYMPOSIUM ON ROOFING TECHNOLOGY, NBS, Gaithersburg, MD, sponsored by NBS and the National Roofing Contractors Association; contact: Robert G. Mathey, B348, Building Research, 301/921-3407.

September 28-30

DATA ELEMENT MANAGEMENT SYMPOSIUM, NBS, Gaithersburg, MD; sponsored by NBS and ANSI Committee X3L8; contact: Hazel McEwen, B226 Technology Building, 301/921-3157.

October 3-6

ALTERNATIVES FOR CADMIUM ELECTROPLATING IN METAL FINISHING, NBS, Gaithersburg, MD; sponsored by NBS, Consumer Product Safety Commission, Department of Defense, Department of Interior, Occupational Safety and Health Administration, Environmental Protection Agency, Food and Drug Administration, and General Services Administration; contact: Fielding, Ogburn, B166 Polymers Building, 301/921-2957.

October 11-13

MATERIALS FOR COAL CONVERSION AND UTILIZATION, NBS, Gaithersburg, MD; sponsored by NBS, Energy Research and Development Administration, Electric Power Research Institute; contact: S. J. Schneider, B303, Materials Building, 301/921-2893.

October 11-14

COMPUTER PERFORMANCE EVALUATION USERS GROUP, 13TH MEETING, New Orleans, LA., sponsored by NBS; contact: Dennis Conti, A265 Technology Building, 301/921-3485.

***October 17-19**

TIME AND FREQUENCY CALIBRATION: METHODS AND RESOURCES, NBS, Boulder, Colo.; sponsored by NBS; contact: Roger Beehler, NBS, Boulder, Colo., 303/499-1000, ext. 3281.

***October 19-20**

RELIABILITY TECHNOLOGY FOR CARDIAC PACEMAKERS, NBS, Gaithersburg, MD; sponsored by NBS; contact: Harry A. Schafft, A327 Technology Building, 301/921-3625.

November 1-3

MECHANICAL FAILURES PREVENTION GROUP, NBS, Gaithersburg, MD; sponsored by NBS and MFPG; contact: Harry C. Burnett, B260 Materials Building, 301/921-2818.

November 13-17

WORKSHOP ON RAPID SOLIDIFICATION TECHNOLOGY, Sheraton-Reston, Reston, VA; sponsored by NBS, ARPA; contact: Dr. Arthur Ruff, B264 Materials Building, 301/921-2811.

December 5-7

WINTER SIMULATION CONFERENCE, NBS, Gaithersburg, MD; sponsored by NBS, the Association for Computing Machinery, the Institute of Electrical and Electronic Engineers, Operations Research Association of America, the Institute for Industrial Engineers, and the Society for Computer Simulation; contact: Paul F. Roth, B250 Technology Building, 301/921-3545.

***April 10-13**

TRACE ORGANIC ANALYSIS: A NEW FRONTIER IN ANALYTICAL CHEMISTRY, NBS, Gaithersburg, MD; sponsored by NBS; contact: Harry S. Hertz, A105 Chemistry Building, 301/921-2153.

***April 17-20**

ACOUSTIC EMISSION WORKING GROUP MEETING, NBS, Gaithersburg, MD; sponsored by NBS; contact: John A. Simmons, B118 Materials Building, NBS, 301/921-3355.

***April 23-26**

AMERICAN NUCLEAR SOCIETY TOPICAL CONFERENCE ON COMPUTERS IN ACTIVATION ANALYSIS AND GAMMA RAY SPECTROSCOPY: Mayaguez, Puerto Rico; sponsored by NBS, American Chemical Society, American Nuclear Society, Energy Research and Development Administration, U. of Puerto Rico Nuclear Center; contact: B. S. Carpenter, B108 Reactor Building, NBS, 301/921-2167.

***May 8-10**

SYMPOSIUM ON REAL-TIME RADIOGRAPHIC IMAGING, NBS, Gaithersburg, MD; sponsored by NBS and the American Society for Testing and Materials; contact: Donald A. Garrett, A106 Reactor Building, 301/921-3634.

* New Listing

PUBLICATIONS

COMPREHENSIVE REVIEW ON NMR KNIGHT SHIFTS

Metallic Shifts in NMR *is Volume 20 of the* Progress in Materials Science *Series by Pergamon Press. The four volume compilation costs $300. 1977 subscribers to* Progress in Materials Science *can obtain the four volumes for $200. The books are available through dealers which carry Pergamon Press books or directly through Pergamon Press, Fairview Park, Elmsford, New York, 10523 and Headington Hill Hall, Oxford, OX3 0BW, England.*

The largest and most comprehensive review of nuclear magnetic resonance (NMR) Knight shifts in metallic media has been written by scientists at NBS and published by Pergamon Press.

The four volume review is titled *Metallic Shifts in NMR: A review of the theory and comprehensive critical data compilation of metallic materials.* It was compiled by Dr. G. C. Carter, Dr. L. H. Bennett, and D. J. Kahan, of the NBS Institute for Materials Research, under the sponsorship of the NBS Office of Standard Reference Data.

The data compilation will be useful to a wide range of scientists and students in the fields of solid state physics, chemistry, metallurgy, and materials science working in industry and research establishments, including those producing new alloys and metallic compounds.

The Knights shift, which is measured almost exclusively by the NMR technique, has far-reaching applications in solid state physics, physical metallurgy, and other areas. For instance, it is very sensitive to details of a metal's Fermi surface and to changes in the Fermi surface caused by alloying, and thus can serve as a sensitive test of models proposed to explain the electronic structure of metals. It is also an important analytical, chemical, or metallurgical tool in both basic and applied studies.

Starting with the basic principles of NMR Knight shifts, the review examines current theories and physical interpretations in relation to other NMR and solid state properties. It also contains tables, graphs, discussions, and phase diagrams. An alphabetical index of metals and alloys in which a nuclear resonance has been observed or discussed in the evaluation is also included.

A GUIDE FOR LAW ENFORCEMENT AGENCIES ON USE OF VOICE SCRAMBLERS

A Guide to Voice Scramblers for Law Enforcement Agencies, *Nelson R. E., Nat. Bur. Stand. (U.S.) Spec. Publ. 480-8, 44 pages (Dec. 1976), Stock No. 003-003-01735-3, $1.05.*

The National Bureau of Standards has produced a simply-written, well-illustrated guide for law enforcement agencies to assist these agencies in the selection and procurement of voice scrambling equipment.

As the guide states in the introduction, "radio communications are not private." Criminals, as well as law-abiding citizens attracted by police activity, have the capability of listening in to police communication systems. The advantages to the law breaker are obvious—knowledge of police movements allows him to plan his own activities. The radio-listening citizen may decide to rush to the scene of a major police activity, perhaps impeding the policeman's job.

Because of these and other problems, some police departments have purchased equipment which can scramble the operator's voice at the point of transmission and unscramble it at the receiving end. Thus the privacy of the communication is maintained. The guide notes that a survey of 428 law enforcement agencies found that 40 used scramblers and that 225 expressed a need for them.

The publication, titled "A Guide to Voice Scramblers for Law Enforcement Agencies," assists police departments in identifying their radio privacy needs and equipment performance requirements. It discusses technical and support considerations and describes in detail the characteristics of various scrambler systems. Finally, it outlines considerations for purchasing scrambler equipment.

PREVENTION OF FAILURES IN COAL CONVERSION SYSTEMS

Prevention of Failures in Coal Conversion, *Shives, T. R., and Willard, W. A., Nat. Bur. Stand. (U.S.), Spec. Publ. 468, 233 pages (Apr. 1977), Stock No. 003-003-01760-4, $3.*

Prevention of failures in coal conversion systems, in which coal is converted to environmentally acceptable gaseous and liquid fuels and chemical feedstocks, is the theme of a new publication from the National Bureau of Standards.

The publication contains 20 papers delivered at the 24th meeting of the Mechanical Failures Prevention Group held in April 1976 at the Battelle, Columbus Laboratories in Columbus, Ohio. Included are a series of lectures dealing with reliability problems in coal conversion systems, economics of failure in energy-generating systems, corrosion, and gaps in engineering data. In addition, failure analysis, materials problems, and related materials research are discussed.

The papers point out that significant reliability problems exist in coal conversion systems. The most important aspect of the problem is the absence of a domestic commercial industry in coal conversion. Reliability data from commercial operations do not exist and must be generated from the next best source: Energy Research and Development Administration (ERDA) sponsored pilot plants and demonstration projects.

The publication describes the ERDA Fossil Energy Failure Prevention System operated for ERDA by NBS to assist plant operating and design personnel prevent plant shutdowns and extend the useful life and reliability of plant components. NBS is responsible for collecting and evaluating all detailed information from the pilot plants and from laboratories conducting diagnostic failure analyses.

This information is stored and catalogued according to coal conversion process, material type, failure category, and component type so that the information is readily accessible. The information is then made available through direct con-

OF THE NATIONAL BUREAU OF STANDARDS

tact with the Failure Prevention Information Center and through published reports from ERDA describing specific problem areas and recommended corrective measures in coal conversion pilot plants.

Acoustics and Sound

Flynn, D. R., Leasure, W. A., Jr., Rubin, A. I., and Cadoff, M. A., *Noise Emission Measurements for Regulatory Purposes,* Nat. Bur. Stand. (U.S.), Handb. 122, 193 pages (Mar. 1977) SD Catalog No. C13.11:122, $2.60.

Atomic and Molecular Studies

Hagan, L., *Bibliography on Atomic Energy Levels and Spectra (July 1971 through June 1975),* Nat. Bur. Stand. (U.S.), Spec. Publ. 362 Suppl. 1, 186 pages (Jan. 1977) SD Catalog No. C13.10:363 Suppl. 1, $2.50.

Electronic Technology

Devaney, J. R., Leedy, K. O., and Keery, W. J., *Semiconductor Measurement Technology: Notes on SEM Examination of Microelectronic Devices,* Nat. Bur. Stand. (U.S.), Spec. Publ. 400-35, 54 pages (Apr. 1977) Stock No. 003-003-01755-8, $1.10.

Kern, W., and Comizzoli, *Semiconductor Measurement Technology: Techniques for Measuring the Integrity of Passivation Overcoats on Integrated Circuits,* Nat. Bur. Stand. (U.S.), Spec. Publ. 400-31 120 pages (Mar. 1977 Stock No. 003-003-01753-1, $1.90.

Li, S. S., *Semiconductor Measurement Technology: The Dopant Density and Temperature Dependence of Electron Mobility and Resistivity in n=type silicon,* Nat. Bur. Stand. (U.S.), Spec. Publ. 400-33, 36 pages (Mar. 1977) Stock No. 003-003-01742-6, 85 cents.

Sawyer, D. E., and Berning, D. W., *Semiconductor Measurement Technology: A Laser Scanner for Semiconductor Devices,* Nat. Bur. Stand. (U.S.), Spec. Publ. 400-24, 72 pages (Feb. 1977) Stock No. 003-003-01739-6, $1.35.

Energy Conservation and Production

Burch, D. M., Kusuda, T., and Blum, D. G., *An Infrared Technique for Heat-Loss Measurement,* Nat. Bur. Stand. (U.S.), Tech. Note 933, 52 pages (Apr. 1977) Stock No. 003-003-01746-9, $1.10.

Kelly, G. E., and Bean, J., *Dynamic Performance of a Residential Air-to-Air Heat Pump,* Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 93, 18 pages (Mar. 1977) Stock No. 003-003-01691-8, 45 cents.

Kreider, K. G., and McNeil, M. B., Eds., *Waste Heat Management Guidebook,* Nat. Bur. Stand. (U.S.), Handb. 121, 150 pages (Feb. 1977) Stock No. 003-003-01669-1, $2.75.

Measurement Science and Technology Policy and State-of-the-art Surveys

Jacobs, M., and Washburn, S. A., Eds., *Activities of the National Bureau of Standards,* Nat. Bur. Stand. (U.S.), Spec. Publ. 467, 40 pages (Mar. 1977) Stock No. 003-003-01716-7, $1.20.

Rossmassler, S. A., Ed., *Materials Information Programs—An Interagency Review of Federal Agency Activities on Technical Information About Materials. Proceedings of a Conference held at the National Bureau of Standards, Gaithersburg, Md., Apr. 16 and 17, 1974,* Nat. Bur. Stand. (U.S.), Spec. Publ. 463, 271 pages (Jan. 1977) Stock No. 003-003-01701-9, $3.35.

Nuclear Physics and Radiation Technology

Ghose, A. M., Gopinath, D. V., Hubbell, J. H., and Roy, S. C., Eds., *Proceedings of the International Symposium on Radiation Physics, held at Bose Institute, Calcutta, India, Nov. 30-Dec. 4, 1974,* Nat. Bur. Stand. (U.S.), Spec. Publ. 461, 268 pages (Jan. 1977) Stock No. 003-003-01733-7 $3.25.

Standard Reference Data

Farhataziz, N. N., and Ross, A. B., *Selected Specific Rates of Reactions of Transients from Water in Aqueous Solution. III. Hydroxyl Radical and Their Radical Ions,* Nat. Bur. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 59, 122 pages (Jan. 1977) Stock No. 003-003-01731-1, $1.90.

Other Subjects of General Interest

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NEWS BRIEFS

COMPUTER INSTITUTE DIRECTOR GOES TO DOD. Dr. Ruth M. Davis, who came to NBS in 1970 to head the computer sciences and technology program, left the Bureau this month to assume a position with the Defense Department. Davis is now serving as Under Secretary of Defense for Research and Advanced Technology. Zane Thornton, formerly deputy director of the NBS Computer Institute, has been named acting director.

LEAD ON THE RANGE. The amount of lead in the air in indoor firing ranges often reaches hazardous levels, sometimes resulting in hospitalization of range instructors for lead poisoning. NBS found that the cartridge primer and the bullet--or projectile--were the main sources of lead contamination and recommended using jacketed soft-point projectiles in indoor firing ranges.

NBS TO IDENTIFY SOLAR COLLECTOR TESTING LABS. NBS has awarded a contract to the Air Conditioning and Refrigeration Institute Foundation, Inc., (ARIF) to identify laboratories that are interested in and are capable of testing solar collectors for use in the National Solar Heating and Cooling Demonstration Program. The contract is being carried out with financial support from the Energy Research and Development Administration and the Department of Housing and Urban Development. Interested testing laboratories should contact Robert Evans, ARIF, Inc., 1815 North Fort Myer Drive, Arlington, Virginia 22209.

CLOTHES DRYERS TESTED. The NBS Product Engineering Division is running 16 clothes dryers almost around the clock to measure if their energy efficiency changes with use. The tests are designed to simulate a lifetime for the appliance. The work is part of NBS efforts for the Federal Energy Administration energy conservation program for appliances. A spinoff of the project is information on whether laboratory tests can estimate how long dryers can run until they need repair.

DISTINGUISHED LECTURES PUBLISHED. The series of lectures by distinguished scientists and engineers that were held at NBS during its 75th anniversary year has been published. Science and Technology in America: An Assessment contains seven lectures on materials, metrology, mathematics, chemistry, computers, energy, and engineering, as well as an overview of science and technology in America by Dr. Edward Teller. Order from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for $2.50. (Use SD Stock No. 003-033-01728-1.)

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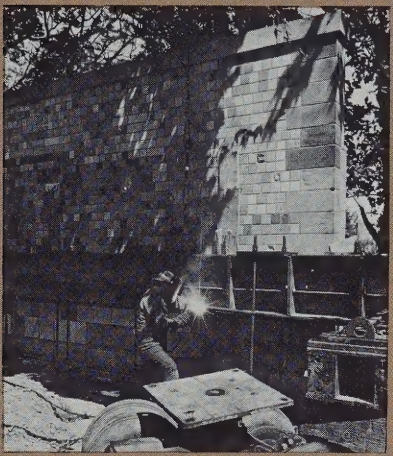

Treasured works of stone in many parts of the world are deteriorating and in some cases approaching ruin at an alarming pace. Research to preserve stone art and architecture is discussed in the August issue of DIMENSIONS/NBS.

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Prepared by the NBS Office of Information Activities
Washington, D.C. 20234
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